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PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XVI. Nos. 217—230.
JANUARY—DECEMBER, 1900.

EDITED BY THE SECRETARIES

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DATES OF ISSUE OF THE MONTHLY NUMBERS OF THE JOURNAL OF THE CHEMICAL SOCIETY TO FELLOWS.

January number was issued		1st January.
February	,,	1st February.
March	,,	1st March.
April	,,	2nd April.
May	,,	1st May.
June	,,	1st June.
July	,,	2nd July.
August	,,	1st August.
September	,,	1st September.
October	,,	1st October.
November	,,	1st November.
December	,,	1st December.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to J. McCrae, for an investigation of some tartaric acid esters of higher alcohols, and the acidyl derivatives of these.

£20 to F. C. Garrett and J. A. Smythe, for an examination of the basic substances contained in the Broxburn shale ore.

£15 to E. J. Russell, for an examination of the effect of the addition of successive increments of moisture on the rate of oxidation of phosphorus.

£15 to A. Lapworth, for an examination of the application of the 'Claisen' reaction to $\alpha\beta$-unsaturated acids and their allied compounds.

£10 to A. Lapworth, to continue the examination of some acids derived from camphor.

£10 to H. O. Jones, to investigate the nature and limits of the isomerism of partially asymmetric nitrogen compounds of the types $NR'R''R'''_2X$ and $NR'_2R''_2X$.

£15 to J. J. Sudborough, to re-determine the esterification constants of some substituted acrylic acids, and to determine them for some *n*-fatty acids, *o*-substituted benzoic acids, and α- and β-substituted propionic acids. To continue work on combination of aromatic bases with trinitrobenzene, &c., and on stilbene derivatives.

£10 to G. D. Lander, to investigate alkylation by means of silver oxide and alkyl halides, more particularly the alkylation of amides and anilides, with production of imino-ethers.

£10 to George Young, to continue investigations into the structure of amidothiodiazoles.

£50 to W. J. Pope, to extend his investigation of optically active substances to compounds of other asymmetric elements than those already described.

£10 to J. Wade, to continue the investigation of the constitution of hydrogen cyanide by ascertaining (a) the mechanism of the conversion of the isocyanides into nitriles, (b) whether the aldehyde compounds with hydrogen cyanide resemble those of isocyanides or nitriles, (c) the cause of the non-formation of isocyanides and the formation of nitriles when potassium cyanide is heated with alkyl iodides in presence of alcohol.

LIST OF FELLOWS ELECTED DURING 1900.

Name.	Proposed.	Elected.
Ashton, James	April 5th	June 21st.
Aston, Bernard Cracroft	November 15th	December 6th.
Bain, Alexander William, B.A.	February 15th	May 3rd.
Baker, Frederick Nolan.	January 18th	February 15th.
Battle, George Edward, B.A.	May 3rd	June 21st.
Bennett, Alexander Hutcheon	December 7th, 1899	February 15th.
Bennett, George Lowe, M.A.	November 1st	December 16th.
Beringer, Heinrich Rowland	March 15th	May 3rd.
Bilimoria, Hormasji Naoroji, M.A., B.Sc.	November 15th	December 6th.
Binks, Frederick Nisbet	November 1st	,, ,,
Boyes, Herbert James Singleton	,, ,,	,, ,,
Britten, Frank Curzon, B.A.	February 1st	May 3rd.
Brooke, Charles Berjen, jun.	May 17th	June 21st.
Brooke, John Richard	March 15th	May 3rd.
Burnett, Theodore Ridley, Ph.D.	November 1st	December 6th.
Calvert, Sidney, M.A., B.Sc.	December 21st, 1899	February 15th.
Cantin, Angélo	May 17th	June 21st.
Chater, Arthur Brand	March 15th	May 3rd.
Cheeseright, John Henry	November 1st	December 6th.
Cole, Oscar Joseph	December 7th, 1899	February 15th.
Comber, Albert Walter	November 1st	December 6th.
Cooper, William Francis, B.A.	January 18th	February 15th.
Courtman, Ernest Owen	May 17th	June 21st.
Cullinan, Nicholas, M.D.	March 15th	May 3rd.
Cussons, John, B.Sc.	,, ,,	,, ,,
Davidson, Alexander	November 1st	December 6th.
Davis, Arthur Charles	February 15th	May 3rd.
Davison, Thomas Cuthbert	December 7th, 1899	February 15th.
Dawson, Harry Medforth, B.Sc., Ph.D.	,, ,, ,,	,, ,,
Deerr, Noël Fielding	February 15th	May 3rd.
Dixon, Stephen M., B.A.	December 7th, 1899	February 15th.
Donald, William	March 15th	May 3rd.
Eadie, Robert	February 1st	,, ,,
Ellis, Frederic Richard	March 15th	,, ,,
Fechtner, Arthur Louis William	November 1st	December 6th.
Findlay, Alexander, M.A., B.Sc.	January 18th	February 15th.
FitzGibbon, Thomas	March 15th	May 3rd.
Foulds, James	December 7th, 1899	February 15th.
Fowler, Morris Broad	February 1st	May 3rd.
Freeman, Willie Ludford, B.A.	November 1st	December 6th.
Gasson, William	,, ,,	,, ,,
Gee, Granville Reginald	December 21st, 1899	February 15th.
Geldard, Julius	January 18th	,, ,,
Gibbings, George William	November 1st	December 6th.
Gibson, John	,, ,,	,, ,,
Gompertz, Richard Henry Cyril, B.Sc.	April 5th	June 21st.
Gough, John Henry	May 3rd	,, ,,

Name.	Proposed.	Elected.
Gray, Robert W.	December 7th, 1899..	February 15th.
Gritton, Henry Bertie	May 17th	June 21st.
Halstead, Reginald Gordon	February 1st	May 3rd.
Handcock, Walter Augustus	November 1st	December 6th.
Hargreaves, William Arthur, M.A.	,, ,,	,, ,,
Harker, George, B.Sc.	,, ,,	,, ,,
Hart, Herbert William	November 16th, 1899	February 15th.
Hart-Smith, James	December 7th, 1899..	,, ,,
Harvey, Alfred William	December 21st, 1899	,, ,,
Haynes, James Herbert, B.Sc.	March 15th	May 3rd.
Hemingway, Frank C. R.	November 1st	December 6th.
Henderson, John Brownlie	,, ,,	,, ,,
Hewitt, Samuel	,, ,,	,, ,,
Hewitt, William Henry, B.A.	,, ,,	,, ,,
Hinks, Percy John	May 3rd	June 21st.
Houston, Adam	January 18th	February 15th.
Hudson, Edmund Foster, B.A.	June 7th	December 6th.
Hutchin, Henry William	November 16th, 1899	February 15th.
Ichioka, Tajiro	May 3rd	June 21st.
Jackson, Henry Joshua, B.A., B.Sc.	December 7th, 1899..	February 15th.
Jappé, Adolf	November 1st	December 6th.
Jennings, Henry	March 1st	May 3rd.
Jones, Humphrey Owen, B.A., B.Sc.	November 1st	December 6th.
Joyce, Thomas Goode, B.Sc.	December 7th, 1899...	February 15th.
Kershaw, James Henry	February 1st	May 3rd.
Kilner, George Washington, M.A.	November 1st	December 6th.
Kynaston, William Charles Robert	December 7th, 1899...	February 15th.
Lamb, Morris Charles	November 1st	December 6th.
Lander, George Druce, B.Sc.	,, ,,	,, ,,
Laws, Arthur Robert	December 7th, 1899..	February 15th.
Leathes, John Beresford, M.A., M.B.	May 17th	June 21st.
Liebmann, Adolf, M.A., Ph.D.	February 15th	May 3rd.
Lockhart, Thomas Lamb	March 15th	,, ,,
Macara, Thomas	February 1st	,, ,,
Mackenzie, Thomas Ebenezer	December 21st, 1899.	February 15th.
Mair, William	,, ,,	,, ,,
McCall, William	November 1st	December 6th.
McKenzie, Alexander Ernest	April 5th	June 21st.
McNair, Hugh	,, ,,	,, ,,
Menzies, Alan W. Cranbrook, M.A., B.Sc.	December 7th, 1899..	February 15th.
Meyer, Hans, Ph.D.	November 15th	December 6th.
Morgan, John Livingston Rutgers, M.A., Ph.D.	December 21st, 1899..	February 15th.
Morris, Edgar Ford, M.A.	December 7th, 1899...	,, ,,
Morris, Herbert Newall	,, ,,	,, ,,
Munton, Frederick Thomas	February 15th	May 3rd.
Napper, Sidney Scrivener	May 17th	June 21st.
Naylor, Ernest Brooks, B.Sc.	December 7th, 1899..	February 15th.
Nightingale, Thomas Marginson, B.Sc.	November 1st	December 6th.

Name.	Proposed.	Elected.
Pardy, Alexander	November 1st	December 6th.
Patrick, David Herbert	May 3rd	June 21st.
Paul, John	November 1st	December 6th.
Pearce, Ernest Vivian	,, ,,	,, ,,
Pettigrew, Robert	March 1st	May 3rd.
Phillpotts, Geoffrey Surtees, B.A.	,, ,,	,, ,,
Readman, James Fraser	December 21st, 1899	February 15th.
Riley, Walter A.	January 18th	,, ,,
Row, M. C. Nanjunda, B.A., M.B.	May 17th	June 21st.
Roy, M. Goolab	,, ,,	,, ,,
Sanders, James McConnell	December 21st, 1899.	February 15th.
Sandford, James Wallace	February 15th	May 3rd.
Sargeant, Fred Pilkington	January 18th	February 15th.
Silberrad, Oswald, Ph.D.	May 17th	June 21st.
Smiddy, Timothy A.	May 3rd	,, ,,
Smith, Edward Shrapnell	January 18th	February 15th.
Smith, Herbert Procter	April 5th	June 21st.
Stapleton, Henry Ernest, B.A.	November 1st	December 6th.
Steele, Bertram D., B.Sc.	February 15th	May 3rd.
Storr, Bertram Vincent, B.Sc.	December 7th, 1899	February 15th.
Strong, Archie Hugh	,, ,,	,, ,,
Thornton, Arthur Lambert, B.Sc.	November 1st	December 6th.
Tilley, James Walter	February 1st	May 3rd.
Tomlins, George Edward	April 5th	June 21st.
Traquair, John	May 17th	,, ,,
Walker, Augustus John, B.Sc.	February 1st	May 3rd.
Waterhouse, Gustavus Athol, B.Sc.	December 7th, 1899	February 15th.
Wiechmann, Ferdinand Gerhard, Ph.D.	November 1st	December 6th.
Wilson, Leonard Philip	December 7th, 1899	February 15th.
Woodbridge, Walter Bourne	November 1st	December 6th.
Wright, Herbert Edwards, M.A.	,, ,,	,, ,,

FELLOWS DECEASED.

Name.	Elected.	Died.
Atkinson, Edmund	March 3rd, 1872	May 4th, 1900.
Borland, John	March 1st, 1877	July 7th, 1900.
Boylan, Alfred Hunter	May 6th, 1897	May 6th, 1900.
Branscombe, William Harcourt	February 16th, 1899	
Conroy, Sir John	January 18th, 1866	December 15th, 1900.
Crawley, Henry Howard	March 16th, 1882	September 12th, 1900.
Edwards, John B.	February 7th, 1848	
Ellis, Thomas Flower	April 17th, 1890	January 24th, 1900.
Harris, Frank W.	February 21st, 1884	August 12th, 1900.
Hotblack, Herbert A.	December 7th, 1882	
Hughes, John Elias	May 4th, 1899	January, 1900.
Lawes, Sir John Bennet	June 17th, 1850	August 31st, 1900.
Manning, Frederick Alfred	February 4th, 1858	December 31st, 1900.
Marcet, William	February 7th, 1853	March 4th, 1900.
McConnell, William	June 18th, 1896	June 24th, 1900.
Parsons, William	May 17th, 1888	April 6th, 1900.
Reynolds, Richard	November 19th, 1857	April 5th, 1900.
Richardson, J. G. F.	December 1st, 1864	January 6th, 1900.
Rylands, Thomas Glazebrook	February 16th, 1870	February 14th, 1900.
Shaw, Saville	February 6th, 1890	November 5th, 1900.
Smith, George	December 20th, 1873	
Thorp, William	February 1st, 1866	February 13th, 1900.
Waage, Peter	January 20th, 1898	January 13th, 1900.
Warden, C. J. H.	December 4th, 1873	July 18th, 1900.
Wood, Augustus A.	December 5th, 1867	September, 1900.
Wyatt, Thomas M.	February 19th, 1891	

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3. On the relationship between the constitution of some substances and the fluorescence which they exhibit. By J. T. Hewitt, M.A., D.Sc.	3	—
4. Action of fuming nitric acid on α-dibromocamphor. By Arthur Lapworth and Edgar M. Chapman	4	309
5. Note on Volhard's method for the assay of silver bullion. By T. K. Rose, D.Sc.	5	232
6. *c*-Substituted hydroxytriazoles. By George Young, Ph.D., and Ernest Witham, B.A., B.Sc.	5	224
7. Note on the use of a mixture of dry silver oxide and alkyl halides as an alkylating agent. By G. Druce Lander	6	—
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8. The chlorine derivatives of pyridine. Part V. Constitution of citrazinic acid. Formation of αα′-dichloropyridine and of αα′-diiodoisonicotinic acid. By W. J. Sell, M.A., and F. W. Dootson, M.A.	9	233
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10. The space configuration of quadrivalent sulphur derivatives. Methylethylthetine dextrocamphorsulphonate and dextro-α-bromocamphorsulphonate. By William Jackson Pope and Stanley John Peachey	12	—
11. Nitrocamphane. By M. O. Forster	13	251
12. The absorption spectra of ammonia, &c. By W. N. Hartley, F.R.S., and James J. Dobbie, D.Sc., M.A.	14	318
13. Isoamarine. By Francis R. Japp, F.R.S., and James Moir, M.A., B.Sc.	15	—
14. On the condensation of formaldehyde with ethyl malonate and on the synthesis of pentamethylenetricarboxylic acid. By J. Frank Bottomley and W. H. Perkin, jun.	16	294
15. The volumetric estimation of potassium. By R. H. Adie, M.A., and T. B. Wood, M.A.	17	1076

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16. On the action of aluminium chloride on camphoric anhydride. III. By F. H. Lees and W. H. Perkin, jun.	18	—

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20. Solubility of mixed potassium nitrite and nitrate. By Edward Divers	40	—
21. The combination of sulphur dioxide with oxygen. By Edward John Russell and Norman Smith	41	340
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54. Note on partially miscible aqueous inorganic solutions. By G. S. Newth	87	775
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78. The nitrogen chlorides derivable from meta-chloroacetanilide and their transformations. By F. D. Chattaway, K. J. P. Orton, and W. H. Hurtley	125	800
79. The persulphuric acids. By T. Martin Lowry, D.Sc., and John H. West	126	950
80. On diphenyl- and dialphyl-ethylenediamines, their nitro-derivatives, nitrates, and mercurichlorides. By W. S. Mills, B.A.	127	1020
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82. The ultra-violet absorption spectra of some closed chain carbon compounds. II. Dimethylpyrazine, hexamethylene, and tetrahydrobenzene. By W. N. Hartley, F.R.S., and Jas. J. Dobbie, D.Sc., M.A.	129	846
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ERRATA.

P.	l.	
66	8	*for* "zoeglœa" *read* "zooglœa."
,,	25	,, "hypomicrobium" *read* "hyphomicrobium."
184	6	,, "grams" *read* "grains."
189	1	,, "(5H)" *read* "(SH)."
204	16	,, "$C_{13}H_{19}O_2$" *read* "$C_{13}H_{20}O_2$."
210	37	,, "as represented by" *read* "in accordance with."

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January 18th, 1900. Professor Thorpe, F.R.S., President, in the Chair.

Messrs. E. W. Lewis, A. J. Shelton, S. Blofield, and J. N. Goldsmith were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Frederick Nolan Baker, 3rd Royal Iniskilling Fusiliers, Mullingar, Ireland; William Francis Cooper, Ashlyns Hall, Berkhampsted; Alexander Findlay, Emilienstrasse 10^{I}, Leipzig, Germany; Julius Geldard, 120 Park View Terrace, Otley Road, Bradford; Adam Houston, Brisbane House, Bellahouston, Glasgow; Walter A. Riley, Brunswick Lodge, Newmarket Road, Norwich; Fred Pilkington Sargeant, Springfield Place, Leeds; Edward Shrapnell Smith, 35 Botanic Road, Wavertree Park, Liverpool, E.

Of the following papers, those marked * were read.

*1. "Note on nitrogen halogen compounds." By Julius Stieglitz and E. E. Slosson.

The authors point out that F. D. Chattaway and K. J. P. Orton, in their work on "A Series of Substituted Nitrogen Chlorides, &c." (*Trans.*, 1899, **75**, 1046) have overlooked a series of papers emanating from the Kent Chemical Laboratory of the University of Chicago, in which, since 1893, results of work on the nitrogen halogen compounds in various directions have been given, and a definite line of work undertaken for further investigation. In one of these papers, "Ueber die Einwirkung von unterbromiger und unterchloriger Saeure auf Saeureanilide" (*Ber.*, 1895, **28**, 3265), the preparation and behaviour of acyl-phenyl nitrogen chlorides and bromides are discussed, and some of the compounds obtained by Chattaway and Orton described. In order to avoid future conflict, the line of work pursued by one of the authors and his students is fully outlined as centring in a study of the "Beckmann rearrangement" of acyl-nitrogen halides and analogous bodies.

Further results are given concerning the behaviour of acyl-phenyl nitrogen halides, especially towards alkalis, potassium cyanide, and zinc ethide. All of these reagents reproduce acylanilides. The preparation of acyl-alkyl-nitrogen chlorides and representatives of the series are described: *ethyl benzoyl nitrogen chloride*, $C_2H_5NCl{\cdot}COC_6H_5$, m. p. 53·5°, the corresponding methyl compound is an oil. Alkalis, potassium cyanide, and zinc ethide regenerate the acyl-alkyl-amides.

Further representatives of the isomeric series, the chloro (or bromo) imido-acid esters, $RC(\dot{:}NCl)OC_2H_5$, &c., are given: *chloroimidoethyl metanitrobenzoate*, $NO_2C_6H_4C(NCl)OC_2H_5$, m. p. 61°, the corresponding *bromide* melts at 71°; the analogous *chloroimide* of *β-naphthoic ethyl ether* melts at 68°, the *bromide* at 77°. These ethers are remarkably stable nitrogen halides, perhaps the most stable known. Some have been distilled without decomposition in a vacuum above 100°; boiling alcoholic ammonia does not decompose chloroimidoethylmetanitrobenzoate. Although a number have been obtained in solid form, no stereoisomeric compounds, $RC(\dot{:}NCl)OR$, have as yet been observed, such as exist in the case of the analogous benzhydroximic ethers, $C_6H_5C(\dot{:}NOH)OC_2H_5$. On treatment with zinc ethide, ethylamine derivatives are obtained.

DISCUSSION.

Dr. CHATTAWAY said he regretted that the papers mentioned had been at first overlooked. Dr. Orton and he had approached the subject from an entirely different point of view, and he did not think that their future work was likely to overlap. Professor Stieglitz and his students were working on the Beckmann change, while they were chiefly studying substitution, and endeavouring to show that the chlorination and bromination of anilines and anilides are not direct processes, but that nitrogen chlorides and bromides are always first formed, and under favourable circumstances subsequently undergo isomeric change.

*2. "On the electrolysis of the nitrogen hydrides and of hydroxylamine." By E. C. Szarvasy, Ph.D.

A short account was given of the experiments of the author on the electrolysis of solutions of ammonia, hydrazine, azoimide, hydroxylamine, and of their salts.

The experiments were carried out at different temperatures, and with varying current densities and concentrations. The conditions were determined under which ammonia, hydrazine, and azoimide, on electrolysis, yield their two components in the proportions contained in their molecules respectively, and without the formation of any secondary products.

In the case of hydroxylamine and its salts, both oxidation and reduction products were formed, no matter how the experimental conditions were varied.

Many attempts were made to prepare polymeric nitrogen by electrolysing solutions of azoimide and its salts at very high current densities; this part of the work is still in hand.

*3. "On the relationship between the constitution of some substances and the fluorescence which they exhibit."

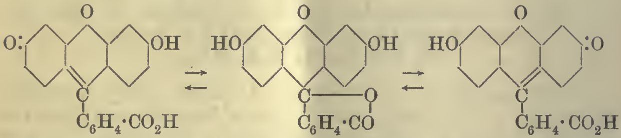
By J. T. Hewitt, M.A., D.Sc.

Since fluorescence is the absorption of radiant energy of definite wave-length or wave-lengths and emission of the same energy after it has been reduced in vibration-frequency, one would expect to find fluorescence usually a property of substances capable of existing in tautomeric forms. As a matter of fact, the colouring matters which do exhibit fluorescence are almost without exception tautomeric, the exceptions which are known being usually substances for which no very great degree of purity can be guaranteed.

But many substances which behave tautomerically do not exhibit well-marked fluorescence; this might well be due to the fact that in a solution in which the two tautomeric forms are in equilibrium the reaction-velocities from one form to the other are so small that a very few of the molecules have the opportunity of absorbing energy when they correspond to one and emitting it in the other configuration.

The case is, however, very different when the molecule in one of its configurations is symmetrical; to pass from this to the other configuration, either of two displacements is necessary, equal in magnitude, but opposite in direction. Just as a pendulum (neglecting the friction due to its support and the medium in which it vibrates) swings regularly between two extreme positions, passing at regular intervals through its lowest point, so a molecule of a substance which exhibits the kind of tautomerism characteristic of fluorescein might undergo continual and frequent change. Fluorescein itself yields derivatives, not only of a phenolic lactone, but also of a quinonecarboxylic acid. The transition from the lactone to the quinonecarboxylic form may be effected by displacement of either of its phenolic hydrogen atoms, the symmetry of the molecule conditioning the equality of energy necessary for displacement of either atom. Hence all the molecules will be undergoing tautomeric change continuously and frequently, and energy absorbed when the molecules have one configuration will be, to an appreciable extent, emitted when they correspond to the other configuration. It is practically certain that the vibration frequency of fluorescein is different in the two states (the diethyl ethers corresponding to the two forms are quite different in the character of their absorption) and hence every opportunity is offered for energy of a rapid vibration frequency to be largely transformed into energy of greater wave-length.

In the case of fluorescein, the condition of a molecule may be symbolised in the following manner:



The greater number of fluorescent dye-stuffs conform to the theory shortly stated above; exceptions may, however, be classed under two heads.

(i) Substances having the requisite structure, but not exhibiting fluorescence.

(ii) Substances exhibiting fluorescence, but not possessing the doubly symmetrical tautomeric structure considered in the case of fluorescein.

It is, however, probable that many of the exceptions are only apparent, the fluorescent spectrum not having been sufficiently examined.

4. "Action of fuming nitric acid on α-dibromocamphor." By Arthur Lapworth and Edgar M. Chapman.

The authors have repeated the work of Kachler and Spitzer on the oxidation of α-dibromocamphor (*Monatsh.*, 1883, 4, 554), and agree with them that camphoronic acid is produced, but the quantity of this substance is small, and it is difficult to separate it from homocamphoronic acid, which is present in much larger amount; on the other hand, they have not been able to detect any isocamphoronic acid, and conclude that Kachler and Spitzer were merely dealing with impure homocamphoronic acid.

The product, to which Kachler and Spitzer gave the provisional formula $C_{24}H_{33}BrN_4O_{12}$, appears to have been a mixture of the substance $C_{10}H_{16}N_2O_6$, already described by the authors (*Trans.*, 1899, **75**, 986), with ordinary nitrobromocamphor, $C_{10}H_{14}OBrNO_2$, produced by the nitration of monobromocamphor formed in the initial stage of the reaction.

Besides the above-mentioned products and dibromocampholid, a number of other substances seem to be formed. One of these remains dissolved in the water with which the mixture is diluted, and cannot be isolated by dilution. It is obtained by extracting the liquid containing the homocamphoronic acid with chloroform, and forms a neutral oil which is not readily soluble in pure water; it is probably a lactone. When this substance is allowed to remain with aqueous potash, it produces an acid having the formula $C_{10}H_{16}O_4$, which forms magnificent, transparent crystals, is sparingly soluble in water and melts at 177°. When distilled, or warmed with strong acids, it undergoes a curious molecular change, yielding an acid, $C_{10}H_{12}O_2$, melting at 167—168°, which has been identified as trimethylbenzoic acid, ($CO_2H : Me : Me : Me :: 1 : 2 : 3 : 4$).

5. "Note on Volhard's method for the assay of silver bullion."

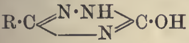
By T. K. Rose, D.Sc.

The precautions to be observed in using the method are described, and the limit of accuracy put at 0·1 per 1000, instead of 0·25 per 1000, as stated by Van Riemsdyk.

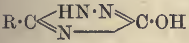
6. "*c*-Substituted hydroxytriazoles."

By George Young, Ph.D., and Ernest Witham, B.A., B.Sc.

The authors have prepared hydroxytriazoles by two actions represented by the equations $R\cdot CH{:}N\cdot NH\cdot CO\cdot NH_2 + O =$



$R\cdot C\left\langle\begin{matrix}N\cdot NH\\ N\end{matrix}\right\rangle C\cdot OH + H_2O$, $R\cdot CHO + NH_2\cdot CO\cdot N{:}N\cdot CO\cdot NH_2 =$



$R\cdot C\left\langle\begin{matrix}HN\cdot N\\ N\end{matrix}\right\rangle C\cdot OH + NH_3 + CO_2$. Where R is the same group, the products of the two actions are apparently identical.

c-Phenylhydroxytriazole, $C_6H_5\cdot C_2N_3H_2O$, m. p. 321—322°. Forms two silver salts, $C_6H_5\cdot C_2N_3HO\cdot Ag$ and $C_6H_5\cdot C_2N_3O\cdot Ag_2$. Acetyl derivative, $C_6H_5\cdot C_2N_3HO\cdot C_2H_3O$, m. p. 248°. *c-Metanitrophenylhydroxytriazole*, $NO_2\cdot C_6H_4\cdot C_2N_3H_2O$, m. p. 304°. Forms two silver salts, $C_8H_5N_4O_3Ag$ and $C_8H_4N_4O_3Ag_2$. Acetyl derivative, $C_8H_5N_4O_3 \cdot C_2H_3O$, m. p. 261—262°. *Cinnamalsemicarbazone*, $C_6H_5 \cdot CH\colon CH \cdot CH\colon N \cdot NH \cdot CO \cdot NH_2$, m. p. 215—216°. c-*Styrenylhydroxytriazole*, $C_6H_5 \cdot CH\colon CH \cdot C_2N_3H_2O$, m. p. 311°. Forms two silver salts, $C_{10}H_8N_3OAg$ and $C_{10}H_7N_3OAg_2$. Monoacetyl derivative, $C_{10}H_8N_3O \cdot C_2H_3O$, m. p. 241—242°. Diacetyl derivative, $C_{10}H_7N_3O \cdot (C_2H_3O)_2$, m. p. 137—138°.

7. "Note on the use of a mixture of dry silver oxide and alkyl halides as an alkylating agent." By G. Druce Lander.

Dry silver oxide and alkyl iodides have been employed in the preparation of the ethereal salts of alkyloxy-acids (*Trans.*, 1899, **75**, 157, 485, 754). The use of the method in the preparation of alkyl derivatives of compounds of other classes has been studied. Optically active ethyl menthyl ether has been prepared by the action of dry silver oxide and ethyl iodide on *l*-menthol. The optically active ether is an oil boiling at 207·5°—209·5° (uncorrected); d 20°/4° = 0·8537 : $[\alpha]_D^{20°} = -98·32°$.

The ethyl and isopropyl ethers of benzoin are obtained by the action of silver oxide and ethyl and isopropyl iodides respectively on benzoin. The ethyl ether crystallises from light petroleum in needles melting at 58—58·5°; compare Limpricht and Jena (*Annalen*, 1870, **155**, 96), and Fischer (*Ber.*, 1893, **26**, 2415). The isopropyl ether, of similar crystalline form, melts at 72—75°.

The action of silver oxide and ethyl iodide on benzamide leads to the formation of ethyl benzimidoether. The hydrochloride melts at 119—120° with evolution of gas; compare Pinner (*Ber.*, 1883, **16**, 1654) and Tafel and Enoch (*Ber.*, 1890, **23**, 103).

The introduction of one ethyl group in place of hydrogen in ethyl acetoacetate can be readily effected by the aid of silver oxide and ethyl iodide. The product consists of ethyl ethylacetoacetate containing, however, approximately 2 per cent. of ethyl β-ethoxycrotonate, melting at 30°, and yielding on hydrolysis ethoxycrotonic acid which melts at 137·5°, with evolution of gas. The introduction of an ethyl group into ethyl ethylacetoacetate, and ethyl malonate by the same method is also possible, but the proportion of the ethyl homologue obtained is small. No indication could be obtained of the production of the ethyl homologue of ethoxycrotonic acid by the action of silver oxide and ethyl iodide.

Ethyl acetosuccinate may be prepared by the action of silver oxide and ethyl iodoacetate upon ethyl acetoacetate.

Further results and details will be given in a subsequent communication.

ADDITIONS TO THE LIBRARY.

I. Donations.

Coppock, J. B. Volumetric analysis; specially adapted to the requirements of students entering for the Advanced Practical Chemistry Examinations of the Science and Art Department, also the Intermediate Science and Preliminary Scientific Examinations of the University of London. London 1899. From the Author.

Henderson, G. G., and M. A. Parker. An introduction to analytical chemistry. London 1899. From the Authors.

II. By Purchase.

Berthollet, C. L. Essai de statique chimique. Two vols. Paris 1803.

Erdmann, H. Lehrbuch der Anorganischen Chemie. Braunschweig 1898.

Lachman, Arthur. The spirit of organic chemistry, an introduction to the current literature of the subject. With an introduction by Paul C. Freer. New York, 1899.

Pamphlets.

Hiortdahl, Th. Om hydrazinets sulfater og alun samt om dets bestemmelse ved overmangansur kali. Christiania 1897. From the Author.

Steuart, D. S.-S. The mineral wealth of Zoutpansberg : the Murchison Range gold-belt (excerpt from the Trans. of the Inst. of Mining Engineers). London 1899. From the Author.

Wardle, Sir Thomas. A paper on art as applied to the weaving and printing of textile fabrics. (Read before the Architectural Association, November 24, 1899.) From the Author.

Waterhouse, J. Teachings of daguerreotype (Traill Taylor Memorial Lecture III., 1899). From the Author

PROCEEDINGS OF THE ROYAL SOCIETY.

A few volumes of the above may be obtained by Fellows, in the order of application, from the Assistant Secretary, Chemical Society, Burlington House, W., at the price of 10*s.* per vol. Vols. 8–12, 15–24, 27, 37–45 are in stock.

At the next meeting, on Thursday, February 1st, 1900, the following papers will be communicated by the authors :—

"The chlorine derivatives of pyridine. Part V. Synthesis of $\alpha\alpha'$-dichloropyridine. Constitution of citrazinic acid." By W. J. Sell, M.A., and F. W. Dootson, M.A.

"The formation of heterocyclic compounds." By S. Ruhemann and H. E. Stapleton.

"The space configuration of quadrivalent sulphur derivatives. Methyl ethyl thetine dextrocamphorsulphonate and dextrobromocamphorsulphonate." By W. J. Pope and S. J. Peachey.

"Nitrocamphane." By M. O. Forster.

VICTOR MEYER MEMORIAL LECTURE.

The Victor Meyer Memorial Lecture will be delivered by Professor T. E. Thorpe, F.R.S., President of the Society, on the evening of Thursday, February 8th, 1900, at 8.30.

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February 1st, 1900. Professor Thorpe, F.R.S., President, in the Chair.

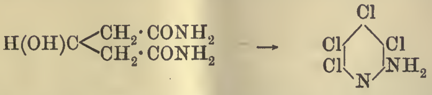
Certificates were read for the first time in favour of Messrs. Frank Curzon Britten, 21 Osbaldeston Road, London, N.; Robert Eadie, junr., 31 Clarendon Street, Partick, N.B.; Morris Broad Fowler, 30 West Park, Clifton, Bristol; Reginald Gordon Halstead, 3 Rathbone Place, Oxford Street, London, W.; James Henry Kershaw, 21 Richmond Park Road, Kingston-on-Thames; Thomas Macara, 6 West Bank Terrace, Hillhead, Glasgow; James Walter Tilley, 2 Stockwell Crescent, London, S.W.; Augustus John Walker, 3 Arnold Street, Hull.

Of the following papers, those marked * were read.

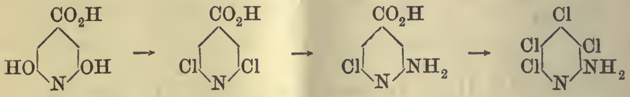
*8. "The chlorine derivatives of pyridine. Part V. Constitution of citrazinic acid. Formation of $\alpha\alpha'$-dichloropyridine and of $\alpha\alpha'$-diiodoisonicotinic acid." By W. J. Sell, M.A., and F. W. Dootson, M.A.

Although its genetic relationships leave little room for doubt that in citrazinic acid the hydroxyl groups occupy the $\alpha\alpha'$-positions relatively to the nitrogen, in view of the importance of this compound and its derivatives it was deemed expedient to obtain confirmatory evidence. This was done as follows:

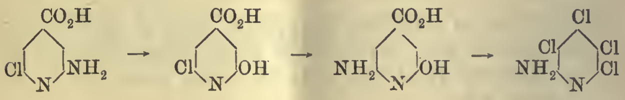
The diamide of β-oxyglutaric acid was prepared and treated with phosphorus pentachloride, when aminotetrachloropyridine was obtained. In this compound, the nitrogen atoms must be adjacent, thus:



By the action of phosphorus pentachloride on citrazinic acid, dichloroisonicotinic acid was obtained by Behrmann and Hofmann (*Ber.*, 1884, 17, 2694) and by the authors (*Trans.*, 1897, 71, 1069), and this interacts with ammonia to form aminochloroisonicotinic acid. (*Trans.*, 1897, 71, 1075), which substance, on further treatment with phosphorus pentachloride, loses its carboxyl group, and yields an aminotetrachloropyridine identical with that mentioned above. These changes may be represented thus:



In this way, the postition of one of the hydroxyl groups is shown. That both hydroxyl groups occupy the same relative position in the molecule is demonstrated by the following reactions: Aminochloroisonicotinic acid was treated with nitrous acid by a modification of Bouveault's method (*Trans.*, 1898, 73, 781), and chlorohydroxyisonicotinic acid obtained. This substance is identical with the product obtained by the action of soda on dichloroisonicotinic acid, as was shown by the melting point of the methyl ester. The acid, on treatment with aqueous ammonia, yielded a compound free from chlorine, which proved to be aminohydroxyisonicotinic acid, and by its interaction with phosphorus pentachloride the latter was converted into α-aminotetrachloropyridine, also identical with that mentioned above. These changes are thus shown:



The reduction of dichloroisonicotinic acid to isonicotinic acid by hydrogen iodide has been described by Behrmann and Hofmann (*loc. cit.*, p. 2696). The authors show that an interesting intermediate compound, diiodoisonicotinic acid, is produced.

By heating the silver salt of αα′-dichloroisonicotinic acid in a stream of carbon dioxide, αα′-dichloropyridine was obtained. This compound melts at 87—88°, and is identical with the dichloropyridine obtained by the interaction of pyridine and phosphorus pentachloride *Trans.*, 1898, **73**, 433).

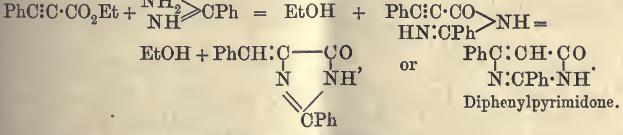
DISCUSSION.

Dr. RUHEMANN said that if the work of Behrmann and Hofmann left any doubt as to the position of the hydroxyl groups in citrazinic acid, it had been completely removed by the study of the action of ammonia on ethyl aconitate. The only explanation possible of this reaction was that ammonia effected the ring formation by condensing with the two carboxyl groups, and that the oxygen atoms in the citrazinamide thus were in the *αα'*-positions. Confirmatory evidence was given also by the formation, in an analogous manner, of the dicarboxylic acids derived from *αα'*-dihydroxypyridine.

Mr. SELL, in reply, pointed out that, although by no means minimising the value of proofs of constitution derived from methods of formation, especially where the yield was approximately theoretical, he was of opinion that where (as in the cases cited by Dr. Ruhemann) something like 80 per cent. of the materials are converted into substances as yet unidentified, it was most essential that independent and conclusive evidence should be brought forward.

*9. "The formation of heterocyclic compounds." By S. Ruhemann and H. E. Stapleton.

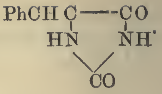
The authors have continued the investigation of the interaction of organic bases and ethereal salts of acids of the acetylene series, and have found that the action of bases on ethyl phenylpropiolate gives rise to heterocyclic compounds. In the case of benzamidine, when the reaction takes place at the temperature of the water-bath, besides the benzalphenylglyoxalidone previously described (Ruhemann and Cunnington, *Trans.*, 1899, **75**, 954), *diphenylpyrimidone* is formed. This shows that benzamidine first reacts with the ethereal group of ethyl phenylpropiolate, forming a substituted amide, which subsequently condenses to a cyclic compound, thus:



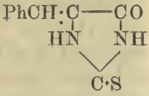
$$\mathrm{PhC{:}C{\cdot}CO_2Et} + \begin{matrix}\mathrm{NH_2}\\ \mathrm{NH}\end{matrix}\!\!>\!\mathrm{CPh} = \mathrm{EtOH} + \begin{matrix}\mathrm{PhC{:}C{\cdot}CO}\\ \mathrm{HN{:}CPh}\end{matrix}\!\!>\!\mathrm{NH} =$$

Benzal phenylglyoxalidone.

Diphenylpyrimidone.

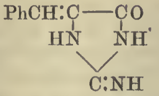
The compound formed with urea, previously described as a simple ureide, they now find to be benzalhydantoin, 

Similarly, thiourea and guanidine yield respectively,



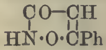
Benzal thiohydantoin.

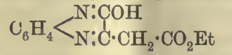
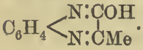
and



Benzal imidohydantoin.

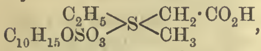
The constitution of these substances is proved by their giving α-hydroxycinnamic acid when boiled with potash.

The authors further show that the compound previously described as phenylpropiolohydroxamic acid, is α-phenyl-γ-isoxazolone  $\begin{array}{l}CO-CH\\ HN\cdot O\cdot CPh\end{array}$

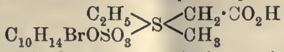
With ethyl acetylenedicarboxylate, o-phenylenediamine gives ethyl quinoxalidoneacetate,  $C_6H_4<\begin{array}{l}N{:}COH\\ N{:}C\cdot CH_2\cdot CO_2Et\end{array}$ (m. p. 210°), which on hydrolysis loses carbon dioxide, giving methylquinoxalidone,  $C_6H_4<\begin{array}{l}N{:}COH\\ N{:}CMe\end{array}$.

The authors found that ethyl propenetetracarboxylate (formed by the union of the ethyl salts of malonic and acetylenedicarboxylic acids) reacts with ammonia, giving ethyl αα′-dihydroxypyridine-βγ-dicarboxylate, which, on hydrolysis with hydrochloric acid, loses the β ·CO_2H group, and yields citrazinic acid.

*10. "The space configuration of quadrivalent sulphur derivatives. Methylethylthetine dextrocamphorsulphonate and dextro-α-bromocamphorsulphonate." By William Jackson Pope and Stanley John Peachey.

On treating methylethylthetine bromide in aqueous solution with the corresponding quantity of silver dextrocamphorsulphonate, filtering and distilling off the water under reduced pressure, a crystalline residue of *methylethylthetine dextrocamphorsulphonate*,  $\begin{array}{r}C_2H_5\\ C_{10}H_{15}OSO_3\end{array}>S<\begin{array}{l}CH_2\cdot CO_2H\\ CH_3\end{array}$, was obtained; after crystallisation at a low temperature from alcohol greatly diluted with ether, it forms colourless, microscopic prisms melting at 115—117°. When pure, it is not hygroscopic, but is extremely soluble in water, alcohol, or acetone.

Methylethylthetine dextro-a-bromocamphorsulphonate,



$$\begin{array}{c}C_2H_5\\C_{10}H_{14}BrOSO_3\end{array}>S<\begin{array}{l}CH_2\cdot CO_2H\\CH_3\end{array}$$

was prepared in a similar manner; it is sparingly soluble in cold acetone, and crystallises in silky white needles melting at 166—168°.

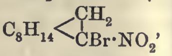
The molecular rotatory powers of these salts in dilute aqueous solution are the molecular rotatory powers of the optically active acid ions, so that the basic thetine group possesses no optical activity; no resolution of the asymmetric thetine into optically active components occurs, because more than one-half of the thetine bromide can be isolated as the pure optically active sulphonate. It is further most improbable that both salts are partially racemic and contain a dextro- and a lævo-thetine radicle, because partially racemic substances are of very rare occurrence.

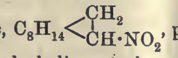
The conclusion is drawn that, if sulphur really exists as a quadrivalent element in these salts, the four atoms directly and independently attached to the sulphur atom lie in the same plane as the latter, and that quadrivalent sulphur cannot lead to enantiomorphous configurations.

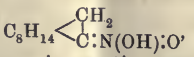
Previous attempts to prepare salts of asymmetric thetines and sulphonium compounds with optically active acids have invariably led to uncrystallisable products; the present are therefore the first observations from which information can be derived respecting the space configuration of quadrivalent sulphur compounds.

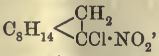
The investigation of these and allied substances is being continued.

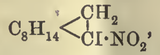
*11. "Nitrocamphane." By M. O. Forster.

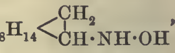
The compound, $C_{10}H_{16}O_2NBr$, obtained by the action of potassium hypobromite on camphoroxime (*Trans.*, 1899, 75, 1141), is a *bromonitrocamphane*,  $C_8H_{14}<\begin{array}{l}CH_2\\|\\CBr\cdot NO_2\end{array}$, although it gives Liebermann's reaction for nitroso-derivatives.

Nitrocamphane,  $C_8H_{14}<\begin{array}{l}CH_2\\|\\CH\cdot NO_2\end{array}$, prepared by reducing bromonitrocamphane with alcoholic potash, melts at 147—148°, and has the specific rotatory power $[\alpha]_D$ $+4\cdot5°$ in alcohol; it gives Liebermann's reaction for nitroso-derivatives, and is indifferent towards alcoholic ferric chloride.

Pseudonitrocamphane,  $C_8H_{14}<\begin{array}{l}CH_2\\|\\C:N(OH):O\end{array}$, obtained on acidifying a solution of nitrocamphane in caustic potash, melts at 74°, and has $[\alpha]_D$ $-95°$ (approximately); it develops a deep cherry-red coloration with ferric chloride, and changes spontaneously into the normal modification either in the solid or dissolved state. In the latter condition, this transformation is accelerated by the influence of piperidine, alkalis, and sunlight. It forms a *potassium* derivative, a *benzoyl* derivative, and a *pseudo-nitrole.*

Chloronitrocamphane,  $C_8H_{14}<\begin{matrix}CH_2\\|\\CCl\cdot NO_2\end{matrix}$, produced when sodium hypochlorite acts on camphoroxime, or when chlorine water is added to a solution of nitrocamphane in caustic alkali, melts at 217°, and has $[\alpha]_D$ $-53{\cdot}1°$ in alcohol; it gives Liebermann's reaction for nitroso-derivatives.

Iodonitrocamphane,  $C_8H_{14}<\begin{matrix}CH_2\\|\\CI\cdot NO_2\end{matrix}$, precipitated from solutions of nitrocamphane in potash by iodine dissolved in potassium iodide, melts at 179°, and has $[\alpha]_D$ $-10{\cdot}8°$ in alcohol; it gives Liebermann's reaction.

Hydroxylaminocamphane (bornylhydroxylamine),  $C_8H_{14}<\begin{matrix}CH_2\\|\\CH\cdot NH\cdot OH\end{matrix}$, prepared by reducing nitrocamphane with aluminium amalgam, crystallises from petroleum in small, oblong plates and melts at 154°; it dissolves in hot water, and the cold solution reduces ferric chloride, ammoniacal silver nitrate and Fehling's solution, almost immediately.

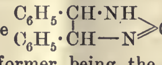
12. "The absorption spectra of ammonia, &c." By W. N. Hartley, F.R.S., and James J. Dobbie, D.Sc., M.A.

It was shown by Soret, and subsequently by Hartley and Huntington, that the purest forms of commercial ammonia which could be purchased (even that stated to be "volcanic ammonia"), contained some substance which exhibited an absorption band which was believed to be due to traces of some constituent of gas-liquor. There was distinct evidence that the band was due to an impurity (*Phil. Trans.*, Part I., 1879, p. 267). An aqueous solution of ordinary ammonia, 150 mm. in thickness, containing 2·5 grams ammonia in 100 c.c. gives a broad absorption band between $1/\lambda$ 3694 (λ 2707) and $1/\lambda$ 4306 (λ 2322). This band becomes less marked when the ammonia is converted into ammonium chloride, and this recrystallised repeatedly. It is altogether absent from ammonia prepared from ammonium oxalate which has been carefully purified by crystallisation. It is also absent from ammonia prepared by the reduction of hydroxylamine hydrochloride. The authors conclude, therefore, that the absorption shown by ordinary aqueous ammonia is due to an impurity which is not of inorganic origin, but is more probably due to pyridine bases. They have, in fact, found that ordinary strong ammonia is contaminated with pyridine bases to the extent of about 0·00014 per cent.

They have measured also the continuous absorption of a normal solution of ammonia 200 mm. and 100 mm. in thickness. Methylamine hydrochloride and hydroxylamine hydrochloride show no selective absorption and are both highly diactinic. A solution of the former 150 mm. in thickness, containing 2·5 grams methylamine in 100 c.c. distilled water, shows practically no absorption, whilst a layer of the latter of the same thickness and strength transmits the whole spectrum with the exception of a few lines at the extreme violet end.

Acetaldoxime and acetoxime show considerable general absorption, but no selective absorption. A solution of acetaldoxime 150 mm. in thickness, containing 1·25 grams acetaldoxime in 100 c.c. of water, absorbs all lines beyond 1/λ 3323 (λ 3009); a layer 25 mm. in thickness of a solution containing 1 milligram-molecule dissolved in 20 c.c. of water gives a continuous spectrum to 1/λ 3952 (λ 2530). Acetoxime shows slightly greater absorption than acetaldoxime, due to the additional methyl group.

13. "Isoamarine." By Francis R. Japp, F.R.S., and James Moir, M.A., B.Sc.

In a recently published note (*Proc.*, 1899, **15**, 211), the authors showed that both ordinary amarine and the isoamarine of Snape and Brooke (m. p. 198°) have the structure  $\begin{matrix}C_6H_5\cdot CH\cdot NH\\ C_6H_5\cdot CH-N\end{matrix}\!>\!C\cdot C_6H_5$, differing only in their configuration, the former being the meso-, the latter the racemic, form. The correctness of this view of the constitution of isoamarine was confirmed by the synthesis of this compound by heating *r*-diphenylethylenediamine with benzoic acid, and subsequently by its resolution into the enantiomorphs by Snape (*Proc.*, 1899, **15**, 228).

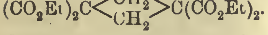
Feist and Arnstein, however, by heating *s*-dibenzoyl-*r*-diphenylethylenediamine in a current of gaseous hydrogen chloride, claim to have prepared an isoamarine melting at 175°, structurally identical with the foregoing (*Ber.*, 1895, **28**, 3177). As a third configuration—apart from those of the separate enantiomorphs, of which there can be no question here—is contrary to what theory predicts, we resolved to re-examine this compound.

We find that it melts at 198° instead of at 175°, and is in every respect identical with the isoamarine of Snape and Brooke.

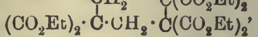
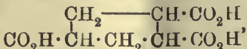
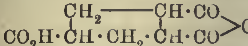
The compound is so easy to purify that the wrong melting point given by Feist and Arnstein is doubtless a mere inadvertence.

14. "On the condensation of formaldehyde with ethyl malonate and on the synthesis of pentamethylenetricarboxylic acid." By J. Frank Bottomley and W. H. Perkin, jun.

In a previous communication by Haworth and Perkin (*Trans.*, 1898, **73**, 330), it was shown that the following substances are formed, either directly or indirectly, by the condensation of formaldehyde with ethyl malonate.

(1) *Ethyl methylenemalonate*, $CH_2{:}C(CO_2Et)_2$, and two polymerides called respectively ethyl *para*-methylenemalonate and ethyl *meta*-methylenemalonate. (2) *Ethyl propanetetracarboxylate*, $(CO_2Et)_2CH\cdot CH_2\cdot CH(CO_2Et)_2$. (3) *Ethyl tetramethylenetetracarboxylate*,  $(CO_2Et)_2C{<}\substack{CH_2\\CH_2}{>}C(CO_2Et)_2$.

In the present paper, the authors show that, under certain conditions, *ethyl pentanehexacarboxylate*, $(CO_2Et)_2CH\cdot CH_2\cdot C(CO_2Et)_2\cdot CH_2\cdot CH(CO_2Et)_2$, is formed by the condensation of 3 mols. of ethyl malonate with 2 mols. of formaldehyde. This new ester is crystalline, melts at 53—55°, and when digested with baryta, is decomposed with formation of an acid which is evidently propanetetracarboxylic acid, $(CO_2H)_2CH\cdot CH_2\cdot CH(CO_2H)_2$, since on heating at 240° it yields glutaric acid. *Pentanetricarboxylic acid*, $CO_2H\cdot CH_2\cdot CH_2\cdot CH(CO_2H)\cdot CH_2\cdot CH_2\cdot CO_2H$, is formed when ethyl hexacarboxylate is hydrolysed with dilute hydrochloric acid, and the resulting acid heated at 200°; it melts at 113—114° and has already been described by Emery (*Ber.*, 1891, **24**, 284). When ethyl pentanehexacarboxylate is heated with sodium ethylate and methylene iodide, it yields ethyl paramethylenemalonate, a remarkable decomposition which is discussed in the paper.

Ethyl pentamethylenehexacarboxylate,  $\begin{array}{l}\qquad\quad CH_2\text{——}C(CO_2Et)_2\\ (CO_2Et)_2\cdot C\cdot CH_2\cdot C(CO_2Et)_2\end{array}$, is formed when the disodium compound of ethyl pentanehexacarboxylate is treated with bromine, and when hydrolysed yields *pentamethylene hexacarboxylic acid* (m. p. 212°). By the elimination of carbon dioxide from this acid, the *cis*- and *trans*-modifications of *pentamethylenetricarboxylic acid*,  $\begin{array}{l}\qquad\quad CH_2\text{———}CH\cdot CO_2H\\ CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO_2H\end{array}$, have been prepared, the former melting at 146—148°, the latter at 127—130°. *Anhydro*-cis-*pentamethylenetricarboxylic acid*,  $\begin{array}{l}\qquad\quad CH_2\text{———}CH\cdot CO\\ CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO\end{array}{>}O$, obtained by heating the *cis*-acid with acetic anhydride, melts at 215—217°, and when treated with water it is again converted into the *cis*-acid.

Experiments are also described on the distillation of the *para*- and *meta*-polymerides of ethyl methylenemalonate, and on the hydrolysis of these polymerides and of ethyl methylenemalonate itself.

15. "The volumetric estimation of potassium." By R. H. Adie, M.A., and T. B. Wood, M.A.

The method proposed by the authors is to precipitate the potassium as cobaltinitrite (of which the formula is usually given as $K_6Co_2(NO_2)_{12},3H_2O$ and to titrate the nitrite with a standard solution of potassium permanganate in acid solution. The experiments of the authors so far seem to show that there are three, instead of two, nitrite groups for each atom of potassium, and that the precipitate they obtain is probably an acid salt, as the ratio of the cobalt to the nitrite is that indicated by the above formula.

The method is as follows. The solution containing the potassium to be estimated is freed from other bases, as far as possible, by means of sodium carbonate, then concentrated if the solution is at all weak, acidified with acetic acid and excess of a solution of sodium cobaltinitrite added. The mixture is allowed to stand for 24 hours, the precipitate collected on a Gooch filter, washed several times with 10 per cent. acetic acid, and finally once with water. The asbestos filter and the precipitate are now transferred to a beaker, and boiled with a dilute solution of soda, filtered, and made up to 100 c.c. Of this solution 20 c.c. are taken, acidified with dilute sulphuric acid, and rapidly titrated with the permanganate solution. A second fraction of 20 c.c. is taken, and to this the amount just found of permanganate solution is added, then acidified, and the end point again determined. In one estimation, the volumes required were 16·3 and 16·4 c.c. respectively. The end of the reaction is more easily obtained if the permanganate is added to the nitrite solution in excess and the excess determined by potassium iodide and thiosulphate solution.

On testing the method with pure potassium salts, it was found that the results, whilst very concordant amongst themselves, gave results too high in almost exactly the proportion 3 : 2 ; 1 c.c. of the permanganate solution used was in this way found to correspond only to 0·0077 gram of K_2O instead of to 0·01175, the value calculated from the formula given above. This seems to indicate for the precipitated salt some formula such as $K_2HCo(NO_2)_6$.

As examples of the accuracy of the method the following analyses are given—

(I) Kainite:

	I.	II.	Mean.
K_2O per cent…….	12·22	11·94	12·13
By platinochloride method:			
K_2O per cent…….	11·98	12·07	12·03

(II) Commercial potassium sulphate :

	I.	II.	Mean.
K_2O per cent.......	50·05	50 82	50·44
By platinochloride method :			
K_2O per cent.......			50·80

(III) Soil :

	I.	II.	III.	IV.	Mean.
K_2O per cent....	1·09	1·20	1 06	1·05	1·10
By platinochloride method :					
	1·11	1·25	0·98	0·97	1·08

The authors are engaged in making a more complete investigation of the composition of the precipitated cobaltinitrite and its decomposition by alkalis, as well as the application of the method to the determination of cobalt.

16. "On the action of aluminium chloride on camphoric anhydride. III." By F. H. Lees and W. H. Perkin, jun.

The authors have already published two notices of their work on the action of aluminium chloride on camphoric anhydride (*Proc.*, 1898, **14**, 111, and 1899, **15**, 23), and in spite of this, M. Blanc (*C. R.*, 1899, **129**, 1019 ; *Chem. Centr.*, 1900, 1, 199) has lately undertaken an investigation of the new substances formed in this reaction which were first obtained by the authors, the examination of which was expressly reserved by them. The authors are therefore compelled to publish the results they have obtained, although the investigation is still incomplete.

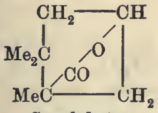
When camphoric anhydride reacts with aluminium chloride at ordinary temperatures, the principal product is *isolauronolic acid*, $C_9H_{14}O_2$, but there is also formed a lactone, $C_9H_{14}O_2$, called by the authors *ψ-campholactone.* This lactone, on hydrolysis with alkalis, yields two hydroxy-acids, $C_9H_{16}O_3$, which melt at 113° and 161° respectively (the melting points 109° and 152° previously given are too low).

When dissolved in a solution of hydrogen bromide in glacial acetic acid, ψ-campholactone is converted into a mixture of bromo-acids, $C_9H_{15}BrO_2$. One of these is liquid, but the other is a solid, melting at 128—130° with decomposition, which when boiled with glacial acetic acid loses hydrogen bromide with formation of an unsaturated acid, $C_9H_{14}O_2$ (m. p. 73°).

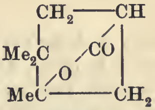
Attempts to reduce the solid bromo-acid with zinc dust and acetic acid led to the formation of a new lactone, $C_9H_{14}O_2$, which melts at 44°, and when hydrolysed with baryta water is converted into the same hydroxy-acid, $C_9H_{16}O_3$ (m. p. 113°), which is obtained by the hydrolysis of ψ-campholactone.

Probably ψ-campholactone and this new lactone are stereoisomeric, and the same remark applies to the two hydroxy-acids melting at 113° and 161°.

It was stated in one of the previous communications (*Proc.*, 1899, **15**, 23) that, when ψ-campholactone is treated with phosphorus pentabromide and the product poured into methyl alcohol, *methyl bromodihydro-ψ-lauronolate* is obtained, and that this methyl ester, on hydrolysis, yields an oily unsaturated acid, $C_9H_{14}O_2$, called *ψ-lauronolic acid.* Since the publication of these results, it has been found that this oily acid, on standing for some weeks, deposits crystals which melt at about 69°, and it is evident that the oily acid is a mixture of two isomeric acids, $C_9H_{14}O_2$, which again are probably stereoisomeric. It was also suggested (*Proc.*, 1899, **15**, 24) that campholactone and ψ-campholactone are possibly closely related, and that this relationship might be represented as follows:

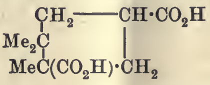


Campholactone.



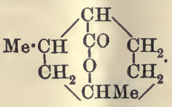
ψ-*Campholactone.*

these expressions being based on the formula



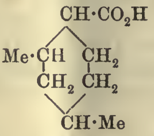
which is one of those suggested by Perkin as possibly representing the constitution of camphoric acid.

When, however, it is remembered that ψ-campholactone, dissolved in concentrated sulphuric acid, is almost quantitatively converted into xylic acid at 90°, and that, as has since been found, ψ-lauronolic acid yields the same acid on prolonged treatment with sulphuric acid at ordinary temperatures, it seems possible that ψ-campholactone may after all be the lactone of *hydroxyhexahydroxylic acid.*



It will be very difficult to prove whether ψ-campholactone is a 5 or 6 ring derivative, since experiments which were made on a considerable scale, with the object of reducing ψ-lauronolic acid—in which case either dihydroisolauronolic acid or hexahydroxylic acid should have resulted and could have been identified—failed owing to the fact that ψ-lauronolic acid is not appreciably attacked even by repeated and prolonged treatment with amyl alcohol and sodium.

When a chloroform solution of camphoric anhydride is left for some weeks in contact with aluminium chloride, the ψ-campholactone remains unchanged, but the isolauronolic acid almost entirely disappears and in its place two saturated acids, $C_9H_{16}O_2$, are found; these have now been separated partly by freezing and partly by means of their crystalline amides. One of these acids is solid, melts at 77°, and is identical with the *hexahydroxylic acid,*



which Bentley and Perkin (*Trans.*, 1897, 71, 173) obtained by the reduction of xylic acid. The other acid, $C_9H_{16}O_2$, is an oil and it is probable that this and the solid acid represent the *cis-* and *trans-*modifications of hexahydroxylic acid. When the acid melting at 77° is treated with bromine and subsequently with alcoholic potash, it yields a solid acid, $C_9H_{14}O_2$ (m. p. 107°), which is identical with the *tetrahydroxylic acid* prepared by Bentley and Perkin (*loc. cit.*).

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, February 15th, 1900.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

Baker, Captain Frederick Nolan,

The Officers' Mess, 3rd Royal Inniskilling Fusiliers, Mullingar.

Late Assistant Master, Stationers' Company's School, London, N., and late Lieutenant, Reserve of Officers; second in command of the G.N.R. Detachment R.E. (Railway Reserve). (Student at Finsbury Technical College.) *a*, Personal interest in the progress of Chemical science; *b*, to obtain the advantage of perusing the Society's publications, and to enjoy the privilege of attending the meetings and using the Library. Among minor qualifications may be mentioned: *a*, the possession of "the Officers'" "Extra" (or Honours) Certificate from the School of Musketry, Hythe, which involves a complete knowledge of the mechanism of small arms and machine guns, and a theoretical and practical acquaintance with the properties of ammunition for the same (this qualifies for a Staff appointment); *b*, the possession of the "P.S." certificate in military engineering from School of Military Engineering, Chatham, in connection with which was a searching examination on the nature and constituents of the nitroglycerine compounds and other explosives largely used in war (qualifies for Staff appointment as Instructor of Engineering).

R. Meldola.
Thomas J. Underhill.
Arthur J. Chapman.
Gerald T. Moody.
William Jackson Pope.

Bennett, Alexander Hutcheon,

61, London Road, Bromley, Kent.

Analytical Chemist. Studied at Dulwich College and at Technical College, Finsbury. Chemist to Messrs. J. B. Lawes and Co.'s tartaric and citric acid works, Millwall, for last 7 years. Engaged in research in conjunction with Mr. Brereton Baker.

John Bennet Lawes.
R. Warington.
H. Brereton Baker.
R. Meldola.
J. Henry Gilbert.
Frank Clowes.

Cole, Oscar Joseph (B.A., Lond.),
Wivenhoe, Colchester, Essex.

Teacher. Science Master, since January, 1898, at West Monmouthshire School, Pontypool. For 3 years previous to January, 1898 (from 1895 to end of 1897), Assistant Science Master at the Grammar School, Carlisle. Being anxious to keep pace with the progress of Chemistry and Chemical discovery.

E. P. Perman.
L. Hansen Bay.
Thos. A. Shegog.
Harry P. Hodgson.
William Briggs.
Thomas Edwards.

Cooper, William Francis,
Ashlyns Hall, Berkhampsted.

B.A., Clare College. Student of Chemistry.

W. J. Sell.
H. J. H. Fenton.
T. B. Wood.
F. W. Dootson.
W. T. N. Spivey.

Davison, Thomas Cuthbert,
49, Victoria Road, New Swindon, Wilts.

Analytical Chemist. At present Assistant to Mr. F. W. Harris, F.C.S., F.I.C., Chief Chemist to the Great Western Railway Co., and Teacher of Practical Chemistry in the Evening Classes at the Swindon and North Wilts. Technical School. The former position held for 8 years and the latter for 6 years.

F. W. Harris.
W. R. Bird.
J. H. B. Jenkins.
T. Judge.
L. Archbutt.

Dawson, Harry Medforth,
Yorkshire College, Leeds.

Demonstrator of Chemistry in the Yorkshire College, Leeds. Late 1851 Exhibition Science Scholar. "On the Conductivity of Flames containing Salt Vapours" conjointly with Professor Smithells and Mr. H. A. Wilson (*Phil. Trans. Roy. Soc.*, **193**, p. 89); "On the Lowering of the Melting Point of Magnesium Chloride Hexahydrate by addition of Foreign Substances," with Prof. van't Hoff (*Zeit. Phys. Chem.*, **22**, 598); "On Magnesium Sulphate with 1½ Molecules of

Water of Crystallisation," with Prof. van't Hoff (*Berichte der Akad. der Wissenschaften Berlin*, 1899); "On the Racemic Transformation of Ammonium Bimalate" conjointly with Prof. van't Hoff (*Berichte*, **31**, 528, *Jahrgang* 1898); "On the Influence of Pressure on the Formation of Tachyhydrite" (Inaugural Dissertation for the Degree of Ph.D. at Giessen), &c. Five years study of Chemistry at the Yorkshire College, Leeds. Three years study of Chemistry at Berlin, Leipzig, and Giessen. Degrees of Ph.D. and B.Sc. (Lond.).

Arthur Smithells. Herbert Ingle.
J. B. Cohen. Henry R. Procter.
J. McCrae.

Dixon, Stephen M.

University, Fredericton, N.B., Canada.

Professor of Civil Engineering, Assoc. M. Inst. C.E. B.A., B.A.I., Senior Moderator and Gold Medallist in Experimental Physics and Chemistry of the University of Dublin. Devoted much attention to Analyses of Ores, Rocks, &c.

J. Emerson Reynolds. Augustus E. Dixon.
Emil A. Werner. Richard J. Moss.
Robert Elliott Doran.

Findlay, Alexander,

Emilienstrasse 10ᴵ, Leipzig, Germany.

1851 Exhibition Scholar. Master of Arts, and Bachelor of Science of Aberdeen University; for one and a half years (1896–1898) Private Assistant to Professor F. R. Japp, F.R.S.; in 1898, elected to an Exhibition (1851) Scholarship, and since then engaged in Research in the Physico-Chemical Institute of Leipzig University. Joint author with Professor Japp of "Phenanthrone" (*Trans.*, 1897); "Condensations of Anhydracetonebenzil and its Analogues with Aldehydes" (*Trans.*, 1899); "Triphenyloxazolone" (*Trans.*, 1899).

F. R. Japp. James Hendrick.
T. S. Murray. James Walker.
Fred W. Skirrow.

Foulds, James,

5, Murray Street, Burnley, Lancashire.

Chemical Master at the Public Higher Grade School, Blackburn. An Associate of the Royal College of Science, London. Late Exhibitioner at the Royal College of Science, London. Late Chemical Master, Wellington College, Salop. Late Chemical Master under the County Council, Salop. Late Chemist to Robertsons, Food Specialists, Manchester.

T. E. Thorpe. Chapman Jones.
W. Palmer Wynne. Barker North.
Sydney Whalley.

Gee, Granville Reginald,

Falcon Villa, Howard Street, Gloucester.

Analytical Chemist. Articled 5 years with G. Embrey, Esq., Public Analyst, City and County of Gloucester. Various successes in S. and A. Dept. Exams., including Queen's Prize (1st on list), Pract. Inorg. Chem., 1892, and 2nd Class Honours, 1894. Studentship at Royal College of Science, 1895—1896. Assistant to Messrs. R. R. Tatlock and Readman, Analytical Chemists, Edinburgh, 1897. Engaged by The Wednesfield Chemical Syndicate to carry out Experimental and Research work in electro-chemical manufacture, 1897—1898, then recalled to Edinburgh.

George Embrey. G. H. Gemmell.
William A. Tilden. George McGowan.
William Ramsay.

Geldard, Julius,

120, Park Field Terrace, Otley Road, Bradford.

Dyeworks Chemist, Messrs. Geo. Armitage, Ltd., Water Lane, Bradford. Three years Dyeing and Chemical Training at the Yorkshire College. One year Original Research with A. G. Perkin, F.C.S., F.R.S.E., with whom I published a paper in your Journal in 1895. Three years at Geo. Armitage, Ltd., as Analytical Chemist, during which I have done a great amount of coal analysis with relation to economy in steam raising.

J. J. Hummel. Arthur Smithells.
A. G. Perkin. Walter M. Gardner.
Walter Leach.

Gray, Robert W.,

7, Orme Court, Bayswater.

Student. Three years Student in Chemical Laboratory, University College, Gower Street. Tufnell Scholar.

William Ramsay. Alex. M. Kellas.
Morris W. Travers. Edward C. Cyril Baly.
S. Smiles.

Harvey, Alfred William,

13, Pendrell Road, St. Catherine's Park, Hatcham, S.E.

School Teacher. Joint author of paper entitled "The Homogeneity of Dextrolævo-α-phenethylamine Dextrocamphorsulphonate" (*Trans. Chem. Soc.*, 1899, p. 1110).

William Jackson Pope. Walter C. C. Pakes.
Stanley John Peachey. Arthur R. Ling.
Gerald T. Moody.

Hart, Herbert William,

13, Lynwood Villas, Darwen, Lancashire.

Chief Chemist to the Wall Paper Manufacturers, Limited (late Messrs. C. & J. G. Potter). I studied Chemistry during four years with Messrs. Crace-Calvert and Thomson of Manchester, and acted as Assistant to them. Subsequently I held the position of Chemist to the Rossendale Printing Company for four years, where I carried out original investigations in Bleaching, Printing, and Dyeing Processes. Since 1895 I have been chief Chemist to Messrs. C. & J. G. Potter, conducting experiments and supervising the Chemical operations involved in Paper Making and Staining, and in the Recovery of Soda on a large scale from waste Esparto liquors.

William Thomson.
James Porter Shenton.
Harry Bowes.
C. F. Cross.
Thomas Fairley.
Geo. Ward.
C. Estcourt.

Houston, Adam,

Brisbane House, Bellahouston, Glasgow.

Chemist. Two years Student with Dr. J. Clark, City Analyst, Glasgow, &c. One Session: Glasgow and West of Scotland Technical College.

G. G. Henderson.
John Clark.
James Robson.
Matthew A. Parker.
Thomas Gray.

Hutchin, Henry William,

Basset Road, Camborne.

Science Teacher. Three years in Messrs. Chance's Laboratory, Alkali Works, Oldbury, concurrently with tuition in Chemistry and Metallurgy by Messrs. Woodward and Hiorns at the Birmingham and Midland Institute. Two and a half years Chemist in charge at Messrs. Riley and Sons' Chemical Works, Lancashire. Three years Associateship Course, and 1 year as Teaching Scholar at South Kensington. Subsequently 3 years as Teacher in the Camborne School of Mines.

William A. Tilden.
W. Palmer Wynne.
John J. Beringer.
Gilbert T. Morgan.
John Gill.

Jackson, Henry,

Downing College, Cambridge.

B.A. (Cantab), B.Sc. (London), Fellow of Downing College, Cambridge. Assistant Demonstrator of Chemistry in the University Chemical Laboratory, Cambridge. Joint author with H. J. H. Fenton, M.A., F.R.S., "Oxidation of Polyhydric Alcohols in Presence of Iron" (*J. C. S.*, 1899, p. 1), "Crystalline Glycollic Aldehyde"

(*J. C. S.*, 1899, p. 575); with W. J. Sell, M.A., F.I.C., "Synthesis of some Derivatives of $\beta\beta'$-Dipyridyl from Citrazinic Acid" (*J. C. S.*, 1899, p. 507).

H. J. H. Fenton. T. B. Wood.
W. J. Sell. W. T. N. Spivey.
W. H. Mills.

Joyce, Thomas Goode,

The Smallthorns, Stafford.

Analytical Chemist. B.Sc. (Lond.), A.I.C. Associate of the Mason University College, Birmingham. Chemist in the Laboratories of Messrs. Blackwell, Hayes, and Spilsbury, Birmingham.

Percy F. Frankland. W. R. Innes.
C. F. Baker. James Spilsbury.
Godfrey Melland.

Kynaston, William Charles Robert,

9, Harland Road, Higher Tranmere, Birkenhead.

Student of Chemistry. Four years (1894—1898) articled pupil to Messrs. Edward Davies and Son, Analytical and Consulting Chemists, The Laboratory, 28, Chapel Street, Liverpool. Twelve months (1898—1899) Student in the Honours School of Chemistry, Owens College, Manchester.

Edward Davies. William A. Bone.
Francis Henry Tate. Edward J. Russell.
H. B. Dixon.

Laws, Arthur Robert,

48, Waverley Terrace, Newcastle-on-Tyne.

Senior Science Master at the Royal Grammar School, Newcastle. Past Student of the Durham College of Science. Undergraduate, London University. Senior Science Master, Royal Grammar School, Newcastle. Consulting Chemist to Tyne Metal Works, &c.

R. Phillips Bedson. *F. J. Lloyd.*
Saville Shaw. *E. G. Clayton.*
F. C. Garrett. *Wm. Chattaway.*

Mackenzie, Thomas Ebenezer,

6, Cardonald Park Terrace, Cardonald, near Glasgow.

Technical Chemist. Ten years Chemist in the Tharsis Company's Laboratory in Glasgow. Three years Chemist at the Tharsis Mines, Spain. Five years Chemist at the Dalzell Steel Works, Motherwell. Four years Assistant to Mr. J. S. MacArthur. Technical Chemist.

Now Technical Manager of the North British White Lead Company, Limited.

John S. MacArthur.
R. R. Tatlock.
R. T. Thomson.
John Clark.
Edmund J. Mills.
G. H. Gemmell.

Mair, William,

388, Morningside Road, Edinburgh.

Chemist on the staff of the North London Chemical Works (Fletcher, Fletcher & Co.). 1892—1893: Extra-Mural Teacher in Practical Materia Medica and Pharmacy, recognised by the University of Edinburgh, for University College, Dundee, at Dundee Royal Infirmary. 1892—1893: Course of study in Practical Analytical Chemistry: at University College, Dundee, Inorganic and Organic; Winter and Summer Day Sessions; Professor Percy F. Frankland, F.R.S. 1893: University College, Dundee, Lectures in Organic Chemistry; Professor Percy F. Frankland, F.R.S. 1892—1893: Research Work in Clinical Chemistry at Dundee Royal Infirmary. 1893: Author of "Pharmacopœia of Dundee Royal Infirmary," 12mo, pp. 94 (in use at Dundee Royal Infirmary, 1899). 1896: Joint author, with Rai Kanai Lall Dey, Bahadur, C.I.E., F.C.S., formerly Professor of Chemistry in Medical College, Calcutta, of "Indigenous Drugs of India" (Pharmacological and Chemical), 8vo, pp. xl, 387.

Fred W. Fletcher.
Peter MacEwan.
Frank W. Young.
Percy F. Frankland.
M. Carteighe.
Wyndham R. Dunstan.
Thomas Tyrer.

Menzies, Alan W. Cranbrook, M.A., B.Sc.,

11, Howe Street, Edinburgh.

Lecturer in Chemistry. Graduated at Edinburgh, Arts 1897, Science 1898. Assistant Professor of Chemistry, Heriot-Watt College, Edinburgh. "Vans Dunlop" Scholar in Chemistry, Edinburgh University.

Alex. Crum Brown.
J. Gibson.
Leonard Dobbin.
Hugh Marshall.
John S. Lumsden.

Morgan, John Livingston Rutgers,

47, Bayard Street, New Brunswick, New Jersey, U.S.A.

Tutor in Chemical Philosophy and Chemical Physics, Columbia University, New York City. B.Sc. Rutger's College, 1892. A.M. and Ph.D. University of Leipzig, 1895. Author of "Die Bestimmung von Cyaniden auf elektrometrischem Wege" (*Zeit. für physikalische*

Chemie, 17, 513—536); with A. H. Gotthelf, "The Theory of the Formation of Nickel Sulphide" (*Jour. Am. Chem. Soc.*, 21, 494—503); "The Theory of the Separation of Barium, Strontium, and Calcium from the mixed Sulphates" (*Jour. Am. Chem. Soc.*, 21, 522—527); "Three Additions to the Kohlrausch-Ostwald Conductivity Method" (*Jour. Am. Chem. Soc.*, 21, December). Books: *The Principles of Mathematical Chemistry*, from the German of Georg Helm (New York: 1897); *An Outline of the Theory of Solution, and Its Results* (New York: 1897); *The Elements of Physical Chemistry* (New York: 1899).

C. F. Chandler. Samuel Auchmuty Tucker.
Jas. S. C. Wells. Peter T. Austen.
Marston Taylor Bogert.

Morris, Edgar Ford,

69, Shrewsbury Street, Old Trafford, Manchester.

Works Chemist. M.A., Oxford, with Honours in Chemistry formerly Demonstrator in Balliol College Laboratory, Oxford.

John Conroy. A. F. Walden.
D. H. Nagel. J. E. Marsh.
William E. Moss.

Morris, Herbert Newall,

48, Lansdowne Road, Crumpsall, Manchester.

Technical Chemist. Student at Owens College under Schorlemmer, and Zürich University under Merz. For the last six years Works Chemist for Messrs. Levinstein, Ltd. Publication on "Vapours from Heated Sulphuric Acid" (*J. C. I.*, 1898).

G. H. Bailey. W. H. Bentley.
C. Estcourt. Alex. K. Miller.
Jno. Hübner.

Naylor, Ernest Brooks,

73, Castle Street, Bolton.

Science Master. Student during 4 years in the Owens College. Honours B.Sc. in Chemistry (Victoria University) 1898. Science Master (Chemistry and Physics), School of Science, Burnley.

H. B. Dixon. W. T. Lawrence.
W. H. Perkin, jun. D. L. Chapman.
E. J. Russell.

Readman, James Fraser,

50, Jane Street, Glasgow.

Technical Chemist. Two years Assistant Chemist to the Steel Co. of Scotland, Ltd. Nine and a-half years Chemist to the Butterley Co., Butterley, Derbyshire. Two years Chemist to the Parkgate Iron and Steel Co., Ltd., Rotherham. Five years Chemist and Steel Furnace Manager to the New British Iron Co., Ltd., Cradley Heath, Staffordshire. Two years in present situation as Assistant to Mr. J. S. MacArthur, Technical Chemist, Glasgow.

John S. MacArthur.
R. R. Tatlock.
R. T. Thomson.
G. H. Gemmell.
Edmund J. Mills.
John Clark.

Riley, Walter A.,

Brunswick Lodge, Newmarket Road, Norwich.

Brewer and Brewers' Chemist. Two years with Mr. John Heron, F.I.C., studying Pure and Applied Chemistry. Two and a-half years in Lager Beer and other breweries. Member Institute of Brewing, Member Society of Chemical Industry. Am at present Assistant Chemist in Brewers' Laboratory.

John Heron.
Francis Sutton.
Otto Hehner.
Arthur R. Ling.
B. E. R. Newlands.
F. J. Lloyd.
John R. Skelton.
F. Napier Sutton.

Sanders, James McConnell,

37, Summerhill Road, Dartford.

Works Chemist. Late Natural Science Scholar, University of Wales. For two years Assistant Science Master, Eastbourne College. For one year Assistant to Mr. C. J. Wilson, F.I.C., F.C.S. For past two years Chemist at Messrs. Burroughs, Wellcome & Co.'s Works, Dartford.

H. Lloyd Snape.
Charles J. Wilson.
W. C. Reynolds.
Francis H. Carr.
H. A. D. Jowett.

Sargeant, Fred Pilkington,

Springfield Place, Leeds.

Teacher of Chemistry, &c. Applicant was for seven years Pupil of, and Assistant to, Mr. J. T. Brierley, Lecturer on Chemistry at the Chorley Science School; he then underwent a full course of instruction in Chemistry, &c., at the Manchester College of Pharmacy, afterwards holding the post of Assistant Lecturer for nearly two years. He has been Principal of the Leeds College of Pharmacy for the last twelve months, during which time he has also held the posts of Demonstrator in Pharmacy and Toxicology at the Medical School of the Yorkshire College. He holds First Class Certificates in Practical and Theoretical Chemistry (Science and Art Department), and the Minor and Major Certificates of the Pharmaceutical Society. He is author of "Notes on Estimation of Chloral Hydrate" (*Ph. J.*, 4, 9, 236).

Jno. T. Brierley. Frederick W. Branson.
T. Armistead Ward. *C. Sordes Ellis.*
Arthur Smithells.

Smith, Edward Shrapnell,

35, Botanic Road, Wavertree Park, Liverpool, E.

Chemical Engineer, Memb. San. Inst., Memb. Soc. Chem. Ind. At present on the technical staff of The United Alkali Co., Ltd. For six years Head Chemist on the Deacon Chlorine Plant at Gaskell and Deacon's Works, Widnes, 1893 to 1899. Now transferred to Head Office, Technical Department for Investigation of Processes at Consumers' Works in various parts of the country. Only published work, "Some Notes on the Disinfection and Deodorisation of Sewage by Chlorine" (*Jour. Soc. Chem. Ind.*, June, 1898), "Some Experiments upon High-strength Hypochlorite Solutions" (*Jour. Soc. Chem. Ind.*, December, 1898, and March, 1899).

Edward Davies. Boverton Redwood.
George Tate. David L. Salomons.
William Naylor.

Hart-Smith, James,

4, Edenvale Street, Fulham.

Student Teacher in Chemistry, Royal College of Science. Associate of the Royal College of Science in Chemistry. Associate of the Institute of Chemistry.

William A. Tilden. Chapman Jones.
W. Palmer Wynne. M. O. Forster.
G. T. Morgan.

Storr, Bertram Vincent,

17, York Road, Ilford, Essex.

Assistant Chemist, Britannia Works, Ilford. For 4 Sessions (1894—98) a Student at the Yorkshire College, Leeds, taking B.Sc., Vict., with Honours in Chemistry; Priestley Research Scholar at Mason College, Birmingham, 1898—1899; now Research Chemist as above.

Arthur Smithells. Percy F. Frankland.
J. B. Cohen. C. F. Baker.
F. F. Renwick.

Strong, Archie Hugh,

Stoneleigh Villa, 63 Herne Hill Road, Camberwell, S.E.

Analytical Chemist and Assayer. Ten years experience in Analytical

Chemistry, including six years experience as sole Chemist on a Pyrites Mine in Pilley's Island, Newfoundland.

Edw. Riley. F. W. Daw.
James E. Ferguson. Robt. D. Connell.
Isaac S. Scarf.

Waterhouse, Gustavus Athol, B.Sc.,

"Ellerslie," Birrell Street, Waverley, New South Wales.

Student at the Sydney University. Four years of study at the Sydney University, more or less continuously in the Chemical Laboratory. Obtained degree of Bachelor of Science in 1899. At present in the third year of the Mining and Metallurgy course.

A. Liversidge. Basil Turner.
J. A. Schofield. C. Walker.
F. B. Guthrie. *John C. H. Mingaye.*
Thos. Steel.

Wilson, Leonard Philip,

123, Chadwick Road, East Dulwich, S.E.

Student. Associate of the City and Guilds Institute. Leathersellers' Research Fellow at the Central Technical College.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. T. M. Lowry.
William J. Pope.

Authorised by Council, Bye-Law I, (3).

Calvert, Sidney,

Missouri State University, Columbia, Missouri.

Assistant Professor of Chemistry. B.Sc. (1st Class Honours) McGill University, Montreal, 1890. Student Graduate School of Harvard University, 1890—1894. A.M., *ibid.*, 1892. Assistant in Chemistry, *ibid.*, 1892—1894, and private Research Assistant to Prof. C. Loring Jackson, 1892—1894; with C. L. Jackson, "Bromine Derivatives of Metaphenylenediamine" (*Proc. Am. Acad.*, 1894); with same, "On the behaviour of certain derivatives of Benzol containing Halogens" (*Proc. Am. Acad.*, 1894). Appointed Assistant Professor of Chemistry, Missouri State University, 1894. With H. B. Gibson and D. W. May, "Dietary Studies at the University of Missouri, 1895," &c. (U.S. Department of Agriculture, Bulletin No. 31, 1896).

B. J. Harrington. Chas. Baskerville.
W. G. Brown. F. P. Venable.

PROCEEDINGS OF THE ROYAL SOCIETY.

A few volumes of the above may be obtained by Fellows, in the order of application, from the Assistant Secretary, Chemical Society, Burlington House, W., at the price of 10*s.* per vol. Vols. 8–12, 15–24, 27, 37–45 are in stock.

VICTOR MEYER MEMORIAL LECTURE.

The Victor Meyer Memorial Lecture will be delivered by Professor T. E. Thorpe, F.R.S., President of the Society, on the evening of Thursday, February 8th, 1900, at 8.30.

At the next ordinary meeting, on Thursday, Feb. 15th, there will be a ballot for the election of Fellows, and the following papers will be communicated:—

"Ammonium amidosulphite." By Edward Divers and Masataka Ogawa.

"Products of heating ammonium sulphites, thiosulphates, and trithionate." By Edward Divers and Masataka Ogawa.

"Note on the refraction and magnetic rotation of hexamethylene." By S. Young, D.Sc., F.R.S., and Emily C. Fortey, B.Sc.

"The combination of sulphur dioxide and oxygen." By Edward J. Russell and Norman Smith.

"Note on the estimation of gases containing sulphur." By E. J. Russell.

"Apiin and Apigenin. II. Note on Vitexin." By A. G. Perkin.

"The yellow colouring principles of various tannin matters. VII." By A. G. Perkin.

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PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 219.

February 8th, 1900. Extra Meeting. Sir Henry Roscoe, LL.D., F.R.S., Vice-President, in the Chair.

The President, Professor T. E. Thorpe, LL.D., F.R.S., delivered the Victor Meyer Memorial Lecture.

Victor Meyer was born in Berlin on September 8th, 1848, and died in Heidelberg on August 8th, 1897. He was at the time of his death President of the German Chemical Society, and had been an Honorary Foreign Member of the Chemical Society since 1883. As a friend of nearly 30 years' standing, and as one who studied with him under Bunsen, the President had acceded to the request of the Council to record its appreciation of the remarkable services Victor Meyer rendered to the science which he cultivated during the all too short period of his activity with such striking assiduity and success.

Some account was given of Meyer in his student days in Heidelberg, of his early connection with the University Chemical Society, and of his work as one of Bunsen's assistants. In 1868, he entered Baeyer's laboratory at the Gewerbeakademie in Berlin, and began the series of half-dozen investigations which characterised his activity during his three years' stay in the German capital. Special reference was made to his memoir on the constitution of the disubstituted benzenes, and upon his method of introducing a carboxyl group into the molecule of aromatic compounds by the action of sodium formate upon the potassium salt of the aromatic sulpho-acids, and it was shown how the results of his observations led to a revision of the views then held with respect to the orientation of the radicles in the "ortho" and "meta" (salicylic) series.

Meyer's success as a private teacher induced von Baeyer to recommend him to Fehling, who sought assistance, especially in the teaching of modern organic chemistry and in practical work in connection with his duties at the Stuttgart Polytechnic. Although he remained in Stuttgart barely a year, he there made one or two discoveries, especially that of the nitro-compounds of the fatty series, which at once stamped him as an original investigator of a very high order. From Stuttgart he was called to Zürich as the successor of Wislicenus, who had been moved to Würzburg, and, when barely 24 years of age, he was elected Ordinarius and Director of the chemical laboratory of the Polytechnic. The 13 years of Meyer's stay at Zürich constitute the most fruitful and the most brilliant period of his career; before its close he had brought himself within the foremost rank of contemporary investigators. Some idea of his wonderful power of work, and of the stimulus he gave to others, may be gleaned from the fact that during that period the Zürich Laboratory gave close on 130 papers and memoirs to chemical literature. Special stress was laid upon the elaborate investigation of the nitro-compounds of the alkyl series and their derivatives, which continued to occupy Meyer and his pupils for many years. Reference was made to the discovery of the nitrolic and azaurolic acids, and of the pseudonitroles, and it was pointed out how the characteristic colour reactions afforded by the behaviour of nitrous acid with the primary and secondary nitro-paraffins, and its inability to act upon the tertiary compounds, offered a ready means of distinguishing primary, secondary, and tertiary alcohol radicles. It was shown how the same line of inquiry led to the discovery of the group of the azines and of the ketoximes and aldoximes, and what the influence of these discoveries was upon the stereochemistry of nitrogen.

It was at Zürich that Meyer devised his various methods of determining vapour densities, and it was pointed out what an important influence the simple and extremely convenient process, known as the air displacement method, has had upon our knowledge of the true molecular weights of substances. Meyer's work on the dissociation of the halogens was especially referred to. Pyrochemical problems, in fact, continued to interest him to the end, and he was quick to take advantage of any hint which seemed to promise the possibility of their solution. In a lecture before the Naturforscher Versammlung in Heidelberg, he regretted that the lack of vessels of sufficiently refractory material prevented him from working at the higher limits of temperature even then attainable. "There can be no doubt," he said, "that new and undreamt-of discoveries will manifest themselves —that a new chemistry will disclose itself—when we are furnished with vessels that will enable us to work at temperatures at which water can no longer exist, and at which oxyhydrogen gas becomes an uninflammable mixture."

In the autumn of 1882, Meyer was requested to undertake the delivery of the series of University lectures on benzene derivatives which had been interrupted by his friend Weith's death. It was in the course of these lectures that he came upon what is, perhaps, the most brilliant of all his discoveries—that of thiophen. He desired to show his class the indophenin reaction of Baeyer, which, at that time, was held to be indicative of benzene; but, to his astonishment, not a trace of the characteristic blue colour made its appearance, although, as was his wont, he had rehearsed the experiment just prior to the lecture. It happened that his assistant had handed to him a sample of the benzene which had been made in the lecture course by heating benzoic acid with lime, and at once drew his attention to the fact that the rehearsal had been made with the ordinary laboratory supply, which, of course, was derived from coal tar. It was soon definitely established that it was only coal-tar benzene that gave the indophenin reaction. Meyer's first idea was that it might be occasioned by an isomeric, a second benzene found in coal tar; but he quickly ascertained that the reaction was due to some sulphuretted product and that Baeyer's indophenin was a sulphur compound. He found that coal-tar benzene, after repeated shaking with oil of vitriol, no longer reacted with isatin, and it was among the sulphonic acids so formed that he discovered the reactive substance. This he was at first inclined to call *thianthren*, then *thiophan*, next *thiol*, and lastly *thiophen*, to denote that it was a sulphur-containing substance giving derivatives analogous to those of phenyl. Within about six months of his first observation, he was in a position to show to the Swiss Naturforscher Versammlung, by actual preparations, that its chemistry was hardly less extensive than that of benzene itself. In 1888 he published, in the form of a monograph—*Die Thiophengruppe* (Braunschweig: Vieweg u. Sohn)—an account of its condition at that time, from which it appears that, during the preceding five years, no fewer than 106 contributions to its history had been made from his own laboratory, and some 40 from those of others.

On the death of Hübner, Meyer received a call to Göttingen, which he accepted, and where a new laboratory was to be built for him. Here he continued his pyrochemical work, and his investigation of the thiophen derivatives, and began with Paul Jacobson the admirable *Text-book of Organic Chemistry*, which, in the critical selection and arrangement of its material, is unsurpassed. With Auwers, he resumed the study of benzil and its derivatives, which he had begun with Wittenberg and Goldschmidt, and with Münchmeyer he commenced the study of the behaviour of phenylhydrazine towards various groups of oxygen compounds. With Demuth, he undertook the investigation of the sulphuranes. Other notable papers of this period were on isophthalaldehyde; on the negative nature of the phenyl group; on the thio-derivatives of deoxybenzoin and its analogues (desaurins); and with Riecke on the carbon atom and valency.

Stereochemical questions—we owe the phrase to Meyer—occupied much of his thought at this period. His perspicacity and insight are well illustrated in the lecture he gave to the German Chemical Society, in 1890, on the results and aims of stereochemical research. It is of interest to the student as giving a fairly complete historical account of the development of space formulæ, and more especially for the criticism of the work of Baeyer and Wislicenus on the stereochemical formulæ of single-, double-, and treble-linked carbon compounds, and of the stereochemical conceptions of Hantzsch and Werner in the case of nitrogen compounds. To this period belongs also his work on the aromatic nitriles, on tetramethylsuccinic acid, and on the oximes of phenanthraquinone.

Meyer was not destined to remain long in Göttingen. The new laboratory was barely finished when, in 1889, he received a call to Heidelberg, as successor to Bunsen. To Heidelberg accordingly he went with the coveted title of Geheimrath and the promise of a new and enlarged laboratory. Although only forty years of age, he was now, so far as worldly position was concerned, at the summit of his career. In conjunction with a number of his pupils he began the investigation of the conditions determining both the gradual and the explosive combustion of gaseous mixtures, notably of electrolytic gas, and of the simpler hydrocarbons with oxygen. In the case of mixtures of aliphatic hydrocarbons with equivalent amounts of oxygen, it appeared that the temperature of explosion falls as the number of the carbon atoms in the molecule increases; that it is probably lower for primary than for corresponding secondary hydrocarbons; and is less for hydrocarbons containing a double bond than for those containing only single bonds, and is still less for those containing a triple bond.

In 1892, Meyer and Wachter announced the existence of the iodoso-compounds, a series of aromatic derivatives in which the monovalent group IO replaces hydrogen. The study of these compounds led to the discovery of the remarkable substances known as the iodonium bases—compounds in which two of the valencies of the trivalent iodine atom are satisfied by aromatic radicles, while the third is satisfied in the free base by hydroxyl, and in the salts by an acid radicle. The iodonium bases are readily soluble in water, are strongly alkaline, and in their behaviour, as in that of their salts, show a remarkable similarity with the derivatives of silver, lead, and more particularly thallium.

Reference was also made to the study of the conditions determining the formation and hydrolysis of ethereal salts of aromatic acids which occupied Meyer, in conjunction with his pupils, and more especially Sudborough, from 1894 up to the year of his death.

Meyer contributed to the literature of chemistry, either alone or in conjunction with his pupils, upwards of 300 memoirs and papers.

As the director of a large chemical laboratory, and as a laboratory teacher, Meyer worthily followed in the footsteps of Bunsen. He was an admirable lecturer, clear, vigorous, and extremely lucid, and his lectures were most popular. As a teacher, he had a wonderful faculty of infusing enthusiasm into his students. His literary ability, combined with his power of exposition, made him an admirable writer of popular science articles. His merits were recognised in every land where science is cultivated, and he was an Honorary Member of many Continental academies. The Royal Society awarded him the Davy Medal in 1891, and in the spring of that year he attended the celebration of the Jubilee of the Chemical Society, and the eloquent words which he uttered in responding to the toast of "Our Foreign Members" will not readily be forgotten by those who attended the banquet on that occasion.

On the motion of Professor DEWAR, seconded by Dr. ARMSTRONG, a vote of thanks was passed to the President for his lecture.

February 15th, 1900. Professor THORPE, F.R.S., President, in the Chair.

Messrs. J. Dewhirst, Edgar M. Chapman, and Thomas A. Henry were formally admitted Fellows of the Society.

It was announced that the following changes in the Council were proposed by the Council:—

As *Vice-Presidents*—Professor Divers, M.D., F.R.S., and Dr. T. Stevenson, *vice* Professor Ramsay, F.R.S., and Professor Emerson Reynolds, F.R.S.

As *Ordinary Members of Council*—Dr. Chattaway, Professor Collie, F.R.S., Professor Augustus Dixon, M.D., and Mr. W. J. Pope, *vice* Mr. Bevan, Dr. Moody, Dr. H. F. Morley, and Professor Smithells.

Certificates were read for the first time in favour of Messrs. Alexander William Bain, 2, Muswell Rise, Highgate, N.; Arthur Charles Davis, 3, Vinery Road, Cambridge; Noel Fielding Deerr, 26, South Parade, Chelsea, S.W.; Adolf Liebmann, 10, Marsden Street, Manchester; Frederick Thomas Munton, The Oak House, Winsford, Cheshire; James Wallace Sandford, Adelaide, S.A.; Bertram D. Steele, 40, Herndale Road, London, S.W.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:—

Frederick Nolan Baker; Alexander Hutcheon Bennett; Sidney Calvert, M.A., B.Sc.; Oscar Joseph Cole, B.A.; William Francis Cooper, B.A.; Thomas Cuthbert Davison; Harry M. Dawson, B.Sc., Ph.D.; Stephen M. Dixon, B.A.; Alexander Findlay, M.A., B.Sc.; James Foulds; Granville Reginald Gee; Julius Geldard; Robert W. Gray; Alfred William Harvey; Herbert William Hart; Adam Houston; Henry William Hutchin; Henry Jackson, B.A., B.Sc.; Thomas Goode Joyce, B.Sc.; W. C. Robert Kynaston; Arthur Robert Laws; Thomas Ebenezer Mackenzie; Willam Mair; A. W. Cranbrook Menzies, M.A., B.Sc.; J. L. Rutgers Morgan, M.A., Ph.D.; Edgar Ford Morris, M.A.; Herbert Newall Morris; Ernest Brooks Naylor, B.Sc.; James Fraser Readman; Walter A. Riley; James McConnell Sanders; Fred Pilkington Sargeant; Edward Shrapnell Smith; James Hart-Smith; Bertram Vincent Storr, B.Sc.; Archie Hugh Strong; Gustavus A. Waterhouse, B.Sc.; Leonard Philip Wilson.

Messrs. A. W. Crossley, F. J. M. Page, and E. W. Voelcker were appointed to audit the Society's accounts.

Of the following papers, those marked * were read.

*17. "Ammonium amidosulphite." By Edward Divers and Masataka Ogawa.

When dry enough, ammonia does not combine with sulphur dioxide at a low temperature. When less dry, it does so, with such rise of temperature that the product of the union is at once partly decomposed. But by dissolving the ammonia in dry, alcohol-free ether, and passing the sulphur dioxide into the solution, kept very cold, the product is precipitated undecomposed. It is colourless, very deliquescent, and unstable in the air. It dissolves in water with a hissing sound, and, when the water has been well cooled, yields a solution which gives the reactions of ammonium sulphite only. It is also very soluble in absolute alcohol, forming the salt lately described by the authors, ethyl ammoniumsulphite. It is formed from two mols. ammonia and one mol. sulphur dioxide. In a dry atmosphere, at temperatures such as 35°, it loses nearly half of its ammonia, as well as a little water. After the decomposition, no sulphite-forming substance remains, and the mass is somewhat orange-coloured from the presence of a very small quantity of a red substance. A very little sulphate is also present, but the residue consists mainly of substances the composition and nature of which are not yet fully determined. They seem to be thio-amido-sulphonic compounds, as yet unknown, which, by heat, by spontaneous partial hydration, or by treatment with ammonia in alcoholic solution, yield sulphur, sulphur dioxide, sulphate, thiosulphate, amidosulphate, imidosulphate, and, almost certainly, sulphamide; when dissolved in water they give a reaction with silver nitrate, closely resembling, yet not that of a trithionate, for when acidified, their solution gives no sulphur or sulphur dioxide or only mere traces until it has been heated under pressure or for a long time.

The undecomposed salt appears to be correctly named *ammonium amidosulphite,* and to have the formula $NH_2{\cdot}SO_2{\cdot}NH_4$. The preparation of this salt shows Rose's assertion, that the gases unite only in equal volumes forming an orange substance which at once decomposes with water into sulphate and trithionate, to be altogether wrong and to be due to his having failed to prevent the decomposition of the product first formed.

*18. "On the products obtained by heating ammonium sulphites, thiosulphate, and trithionate." By Edward Divers and Masataka Ogawa.

The authors have ascertained that *anhydrous ammonium sulphite* and *pyrosulphite* sublime unchanged at about 150° in a current of dry nitrogen, the vapours being no doubt the dissociated gases. At a temperature somewhat higher, *ammonium trithionate* decomposes into sulphur dioxide, sulphur, and ammonium sulphate. At about 150°, *ammonium thiosulphate* decomposes almost entirely, leaving a residue of sulphur and giving a sublimate of anhydrous ammonium sulphite; very small quantities of ammonia and hydrogen sulphide are also given off, giving rise possibly to a trace of trithionate. According to Spring, ammonium thiosulphate sublimes unchanged, except for temporary dissociation. To obtain the above results, moisture must be absent: the effect of slowly heating *hydrated ammonium sulphite* in a current of dry nitrogen is partly to dehydrate it, partly to convert it into pyrosulphite, at about 120°; and then at about 150°, the residue decomposes into sulphur dioxide and ammonium sulphite (approximately hemihydrated) which sublimes.

Ammonium trithionate, a very deliquescent and unstable salt, not hitherto described, was prepared from the potassium salt by the use of hydrofluosilicic acid and ammonia, being much too soluble to admit of preparation by Plessy's process for the potassium salt. *Ammonium sulphite* was conveniently precipitated by saturating its concentrated solution with ammonia in a cooling mixture, and the *pyrosulphite* by similarly saturating its solution with sulphur dioxide. *Anhydrous ammonium sulphite* was obtained by exposing the hydrated salt in a desiccator over potash in an ammoniacal atmosphere.

*19. "The colour of alkali nitrites." By Edward Divers.

As Boguski (*J. Russ. Chem. Soc.*, 1899, **31**, 543) has published his observation that a solution of sodium nitrite had a slight yellow colour which he could not remove, and which he attributes to the presence of an impurity, the author wishes to recall attention to his own statement (*Trans.*, 1899, **75**, 86) that alkali nitrites have a slight yellow colour, especially in solution, and to Groves' statement in denial of its accuracy (*Proc.*, 1898, **14**, 222). The author desires now to claim accuracy for his own statement. The colour of the potassium salt is much more manifest than that of the sodium salt, principally because of its ability to yield exceedingly concentrated solutions. Solutions of potassium nitrite, three parts of salt in one of water, are strongly yellow, particularly when thoroughly free from turbidity. Solutions of equal strength are equally coloured, whatever has been the source of the nitrite. Alkali nitrites are yellow in the fused state. The author is confident that Boguski's promised endeavour to remove the colour of sodium nitrite will be as futile as were those of chemists, long years ago, to remove the pink colour from manganous salts. Boguski's observation that the solid nitrite is sometimes apparently without colour, depends upon the well known optical effect of fine division in lessening the colour of transparent solids.

*20. "Solubility of mixed potassium nitrite and nitrate." By Edward Divers.

By crystallising out, as far as possible, the nitrate which is mixed with potassium nitrite in its usual method of preparation, there remains a mixture of about three parts of nitrite to one part of nitrate, and this constitutes the ordinary nitrite of commerce. This mixture is soluble in one-fourth its weight of water, although the pure nitrite requires one-third of its weight, and the pure nitrate about four times its weight of water to dissolve it. Accordingly, when a solution of three parts pure potassium nitrite in one part water is digested with powdered potassium nitrate at the common temperature, it readily dissolves up one part of this salt.

DISCUSSION.

In reply to remarks by Messrs. BAKER, W. P. BLOXAM, and SCOTT, Dr. DIVERS said that the ammonium amidosulphite rapidly deliquesced in air, and he quite agreed with Mr. Bloxam's observation as to the great activity of hydrated ammonium sulphite with regard to atmospheric oxygen. As Rose had taken no precautions to maintain a low temperature during the reaction, there was no doubt that the compound resulting from the combination of two volumes of ammonia with one of sulphur dioxide gave off half of its ammonia again under the influence of the high temperature produced in the reaction.

*21. "The combination of sulphur dioxide with oxygen." By Edward John Russell and Norman Smith.

The authors have found that when a mixture of sulphur dioxide and oxygen acts on certain oxides, in addition to the absorption of the sulphur dioxide, part of the sulphur dioxide and oxygen combine forming sulphur trioxide, this being apparently due to the "surface action" of the oxide. The extent of this "surface action" varies with the nature and physical conditions of each oxide. No sulphur trioxide was ever found unless a simultaneous absorption of sulphur dioxide occurred; when manganese peroxide and sulphur dioxide, dried by phosphorus pentoxide, were brought together, no absorption took place, nor was any sulphur trioxide produced on the addition of dried oxygen.

If a mixture of dried sulphur dioxide and oxygen be passed over well-dried platinised pumice heated to 400—450°, very little sulphur trioxide is formed, and the drier the materials the less is the combination.

*22. "Notes on the estimation of gaseous compounds of sulphur." By Edward John Russell.

In this paper, volumetric methods of analysis are given which have been found to work satisfactorily in the estimation of sulphur dioxide, hydrogen sulphide, carbonyl sulphide, and carbon disulphide in gaseous mixtures. It is found that, except in the case of sulphur dioxide, absorption methods are not reliable; as a rule, by far the most satisfactory method is to explode with oxygen. In this explosion, sulphur dioxide and sulphur trioxide are both produced, the amount of the former being determined directly, and that of the latter calculated from the contraction observed after explosion. Sulphur dioxide is best estimated by absorption with a pellet of lead peroxide, since this substance, if freshly washed and not too dry, exerts but little of the surface action which tends to cause some of the sulphur dioxide to combine with part of the oxygen to form sulphur trioxide.

*23. "The influence of the 'nascent state' on the combination of dry carbon monoxide and oxygen." By Edward John Russell.

The author has studied several reactions in which carbon monoxide and excess of oxygen were brought together in the flame of an explosion, one or both being in the nascent condition. Combustion was rarely complete, and the amounts of carbon monoxide left unburnt were found to be very similar to those left unburnt in Dixon's experiments (*Trans.*, 1896, 784), in which dried mixtures of carbon monoxide and oxygen were fired by adding carbon disulphide and oxygen and sparking, although in the present experiments one of the substances (carbon monoxide) was in the nascent condition, whilst in Dixon's experiments it was not. It seems, therefore, that the nascent condition has no great effect in promoting combination between carbon monoxide and oxygen, although the high temperature produced by a violent reaction has a very considerable effect.

The substances used as sources of nascent carbon monoxide were carbonyl sulphide and nickel carbonyl; and for nascent oxygen, chlorine monoxide and chlorine peroxide.

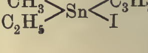
It was discovered incidentally that mixtures of pure carbonyl sulphide and excess of oxygen are not exploded by an electric spark. If, however, a slight amount only of impurity is present an explosion takes place, but combustion is not complete, carbonyl sulphide remaining unburnt in large quantity, along with carbon monoxide, produced by the decomposition of some of the carbonyl sulphide. If the impurity is greater, the combustion is complete.

*24. "Asymmetric optically active tin compounds. Dextromethylethyl-*n*-propyl tin iodide. Preliminary note. By William Jackson Pope and Stanley John Peachey.

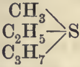
Hitherto no substance containing an atom of tin attached to four different groups has been obtained, owing to the lack of general methods for their preparation.

The authors find that compounds of the type $SnX^{I}X^{II}X^{III}X^{IV}$ can be readily prepared by aid of the following series of reactions from the trimethyl tin iodide described by Ladenburg and Cahours:

(1) $2Sn(CH_3)_3I + Zn(C_2H_5)_2 = 2Sn(CH_3)_3(C_2H_5) + ZnI_2$.
(2) $Sn(CH_3)_3(C_2H_5) + I_2 = Sn(CH_3)_2(C_2H_5)I + CH_3I$.
(3) $2Sn(CH_3)_2(C_2H_5)I + Zn(C_3H_7)_2 = 2Sn(CH_3)_2(C_2H_5)(C_3H_7) + ZnI_2$.
(4) $Sn(CH_3)_2(C_2H_5)(C_3H_7) + I_2 = Sn(CH_3)(C_2H_5)(C_3H_7)I + CH_3I$.

Externally compensated *methylethyl-*n*-propyl tin iodide*,  $\begin{matrix}CH_3\\C_2H_5\end{matrix}>Sn<\begin{matrix}C_3H_7\\I\end{matrix}$,

the final product of reaction (4), is a faintly yellow oil boiling at 270° without decomposition; it is almost insoluble in water, and its vapour exercises unpleasant effects on the mucous membrane.

On agitating the iodide with a warm aqueous solution of a molecular proportion of silver dextrocamphorsulphonate and evaporating the filtered liquid, a copious deposit of *dextromethylethyl-*n*-propyl tin dextrocamphorsulphonate*, $Sn(CH_3)(C_2H_5)(C_3H_7)(C_{10}H_{15}OSO_3)$, was obtained; the salt is only sparingly soluble in cold water, and crystallises in lustrous, square plates melting at 125—126°. In dilute aqueous solution, it has the molecular rotation $[M]_D = +95°$, so that for the monobasic radicle,  $\left.\begin{matrix}CH_3\\C_2H_5\\C_3H_7\end{matrix}\right\rangle Sn-$, $[M]_D$ is about $+45°$.

On evaporating the mother liquor from which this salt had separated, further deposits of the same salt were obtained until all the water had been expelled, and the authors have been unable to isolate a salt of the lævo-base; this behaviour seems due to the conversion of the lævo-base into the dextro-base by continued racemisation in the following manner. The solution of externally compensated base with dextrocamphorsulphonic acid deposits a portion of its dextro-base as the sparingly soluble salt; the excess of lævo- over dextro-base remaining in the solution racemises as evaporation proceeds, a further portion of dextro-base separates as salt, and racemisation of the residue again proceeds. This case is the first of the kind recorded, and affords powerful support to Le Bel's hypothesis respecting the mobility of alkyl groups of low molecular weight in quaternary ammonium salts.

On treating the freshly prepared cold aqueous solution of the dextrocamphorsulphonate with potassium iodide solution, *dextromethylethyl-*n*-propyl tin iodide* separates as a faintly yellow oil; the highest specific rotation of the iodide which has yet been observed is $[\alpha]_D = +23°$ in ethereal solution. The rotation was, however, very variable, and, under conditions not yet understood, the separated iodide was optically inactive. This behaviour is due to racemisation.

It should be noted that the discovery noted above, that racemisation, due to intramolecular mobility, may cause rapid and complete conversion of an externally compensated base into one optically active isomeride, reopens the question of the space configuration of quadrivalent sulphur compounds which, in the light of previous knowledge, seemed to have been determined by our former results (*Proc.*, 1900, 16, 12).

Having now shown that quadrivalent asymmetric tin compounds can exist in enantiomorphously related configurations possessing optical activity, it follows that the space configuration of quadrivalent tin compounds is of the tetrahedral type already established for carbon compounds, and substances of the type of tin tetrachloride must now be regarded as true atomic compounds. Having proved that asymmetric pentavalent nitrogen compounds (*Trans.*, 1899, **75**, 1127) also give rise to optical activity in the same way that van't Hoff and Le Bel proved it for carbon, it may be concluded that all enantiomorphous compounds must be optically active.

In Group IV of the periodic table the non-metal, carbon, is at the top, whilst the metal, tin, is near the bottom; since both can give rise to optical activity in their asymmetric compounds, it is highly probable that all the elements in Group IV lying between these are capable of acting as centres of optical activity. Should this hold for the whole of Group IV, and as it has been shown to hold for nitrogen, the first member of Group V, all the elements of the latter group may be expected to act as optically active centres in appropriate compounds. Compounds of the types $RX^{I}X^{II}X^{III}X^{IV}$ and $QX^{I}X^{II}X^{III}X^{IV}X^{V}$ should therefore be optically active, R being an atom of any element in Group IV, and Q an atom of any element in Group V.

The application of the reactions now described to other elements is in progress, and the authors hope shortly to communicate results obtained with quadrivalent lead compounds.

25. "Note on the refraction and magnetic rotation of hexamethylene." By Sydney Young, D.Sc., F.R.S., and Emily C. Fortey, B.Sc.

The specimen of hexamethylene obtained by one of the authors from Galician petroleum was found to contain a small quantity of a heptane. The hexamethylene was freed from the paraffin by fractional crystallisation, and its refraction and magnetic rotation were determined by Dr. W. H. Perkin, sen. The results obtained are given in the paper.

26. "Apiin and apigenin. Part II. Note on vitexin."

By A. G. Perkin.

By the action of nitric acid on apigenin under varied conditions, four nitro-derivatives have been obtained: *mononitro-apigenin*, $C_{15}H_9O_5(NO)_2$, orange-yellow needles, m. p. about 302°, somewhat soluble in alcohol; *trinitro-apigenin* (*a*), $C_{15}H_7O_5(NO_2)_3$, yellow needles, m. p. about 296°; *trinitro-apigenin* (*b*), yellow needles, m. p. 245—246°, and *tetranitro-apigenin*, $C_{15}H_6O_5(NO_2)_4$, almost colourless needles, m. p. 243—244°. With the exception of the first mentioned, all dissolve with difficulty in the usual solvents. In preparing the mononitro-compound, *dinitro*-p-*hydroxybenzoic acid* was obtained as a decomposition product, a further proof that apigenin does not contain a catechol group (*Trans.*, 1897, **71**, 805). Tetranitro-apigenin appears to be identical with the compound, $C_{15}H_6O_5(NO_2)_4$, obtained from vitexin (*Trans.*, 1898, **73**, 1026), and as the decomposition products of both colouring matters are identical, vitexin must be a derivative of apigenin. The formulæ $C_{21}H_{20}O_{10}$ and $C_{21}H_{13}O_{10}(C_2H_3O)_7$ are now assigned to vitexin and acetylvitexin, and it is suggested that vitexin is *a stable glucoside of apigenin*, and that a like constitution may also apply to scoparin (*Proc.*, 1899, **15**, 123), which, according to this view, is a glucoside of a luteolin monomethyl ether.

Apiin, $C_{27}H_{32}O_{16}$, the glucoside of apigenin occurring in *Apium petroselinum*, is not converted by dilute nitric acid into nitro-apigenin, but into *nitro-apigetrin*, $C_{21}H_{21}O_{11}NO_2$, a yellow, crystalline powder very sparingly soluble in the usual solvents. This is the nitro-compound of a new glucoside, apigetrin, which differs from apigenin in containing but one sugar group. By prolonged digestion with dilute hydrochloric acid, it yields the above mononitro-apigenin.

27. "The yellow colouring principles of various tannin matters. VII." By A. G. Perkin.

The colouring matter of the leaves of *Arctostaphylos uva-ursi* (bearberry) and *Hæmatoxylon Campeachianum* (logwood) is *quercetin*, and this is accompanied by a second substance, probably *myricetin*, to which the green colour of its alkaline solutions are due. *Gallotannic acid* occurs in some quantity in the latter leaves. The leaves of *Rhus metopium* contain *gallotannin*, *myricetin*, and a trace of *quercetin*, but the stem of this plant, unlike *R. cotinus*, and *R. rhodanthema* is devoid of colouring matter. The sparing solubilities of acetylmyricetin and dibromoquercetin have been employed for the separation of myricetin and quercetin. The leaves of *Robinia pseudacacia* contain a feeble colouring matter, *acacetin*, $C_{16}H_{12}O_5$, which yields an *acetyl* derivative, $C_{16}H_{10}O_5(C_2H_3O)_2$, colourless needles, m. p. 195—198°, and on fusion with alkali *phloroglucinol*, p-*hydroxybenzoic acid*, and a trace of *protocatechuic acid*. Acacetin contains one methoxyl group, on removal of which a colouring matter, $C_{15}H_{10}O_5$, results, having the reactions of apigenin. It is thus probably an *apigenin monomethyl ether*. The leaves of *Myrica gale* and *Coriaria myrtifolia* contain respectively *myricetin* and *quercetin*. Although a relationship frequently exists between the tanning and the colouring matters of the same plant (*Trans.*, 1897, **71**, 1138), there is no rule on this point, for exceptions are somewhat numerous.

28. "Note on the bromo-derivatives of camphopyric acid." By J. Addyman Gardner.

An atom of hydrogen in camphopyric acid may be readily replaced by bromine, by the action of the halogen in the presence of phosphorus. Two acids of the formula $C_9H_{13}BrO_4$, are thus obtained and are provisionally named α- and β-bromocamphopyric acid. These acids may be prepared either by treating camphopyric acid with phosphorus pentachloride and subsequently warming with bromine, or by mixing the acid with amorphous phosphorus and adding the proper amount of bromine. In either case, the product is poured into cold water, when part of the acid separates in the solid state and part is extracted with ether from the solution. The α- and β- acids may be separated by repeated crystallisation from benzene.

If only a small amount of water is used to decompose the acid bromides, bromocamphopyric anhydride is also obtained.

α-Bromocamphopyric acid separates from benzene or chloroform as a very light, white, crystalline powder, melting at 167° with previous softening. It is very moderately soluble in hot benzene and chloroform, but only slightly in cold; it is also very soluble in water, ether, acetone and ethyl acetate. It is a dibasic acid, and forms very soluble sodium, barium and ammonium salts.

α-Bromocamphopyric anhydride, $C_9H_{11}BrO_3$, may be obtained by treating the acid in the usual way with acetyl chloride or acetic anhydride. It crystallises readily from benzene in well-defined, tabular crystals which melt at 226—227°. These crystals are very soluble in ether, acetone and ethyl acetate.

β-Bromocamphopyric acid is more soluble in benzene than its isomeride, and is obtained, though in very small quantity, from the mother liquors of the α-acid. It is a white, crystalline substance melting at 207—208°, quite different in appearance from its isomeride. Its barium salt is soluble, and has the formula $Ba(C_9H_{12}BrO_4)_2,4H_2O$; this acid has not, however, been obtained in sufficient quantity for a more complete investigation.

The same products are obtained when camphoic acid is similarly treated with phosphorus pentachloride and bromine.

α-Hydroxycamphopyric acid, $C_9H_{13}(OH)O_4$. If α-bromocamphopyric acid is heated for some time with a 10 per cent. solution of potash, then acidified with hydrochloric acid and extracted with ether, an oily acid is obtained which for the most part solidifies on standing. If this be boiled with benzene, the oily portion dissolves, and a white solid is left which, on crystallisation from water, may be obtained in well-defined, colourless, transparent crystals which melt at 206—207°.

This substance is a dibasic acid and has the formula $C_9H_{14}O_5$. Its sodium and barium salts, which are very soluble in water, were analysed. It is only very slightly soluble in benzene, chloroform, and carbon bisulphide, but dissolves easily in ethyl acetate and in hot water; the oil obtained along with it is apparently an unsaturated acid, but has not yet been obtained in a state of sufficient purity for investigation. These substances are being prepared in quantity, and the author hopes before long to be able to bring before the Society a more complete account of their properties and reactions.

ADDITIONS TO THE LIBRARY.

I. Donation.

Luff, A. P., and Page, F. J. M. A manual of chemistry, inorganic and organic, with an introduction to the study of chemistry. Ill. London 1900. From the Authors.

II. By Purchase.

Gessmann, G. W. Die Geheimsymbole der Chemie und Medicin des Mittelalters. Ill. Graz 1899.

Pamphlet.

Clowes, Frank, and Houston, A. C. Bacterial treatment of crude sewage (supplement to second report). Note on the deposit which accumulates on the coke fragments of the coke-beds at Barking and Crossness. From the Authors.

At the next meeting on Thursday, March 1st, at 8 p.m., the following papers will be communicated :—

"Pilocarpine and the alkaloids of Jaborandi leaves." By H. A. D. Jowett, D.Sc.

"Isomeric partially racemic salts containing pentavalent nitrogen." Parts I to VII. By F. S. Kipping, D.Sc., F.R.S.

"New synthesis of indene." By F. S. Kipping, D.Sc., F.R.S., and Harold Hall.

"Potassium nitrito-hydroximidosulphates and the non-existence of dihydroxylamine derivatives." By E. Divers, D.Sc., F.R.S., and T. Haga, D.Sc.

"Identification and constitution of Fremy's sulphazotised salts of potassium." By E. Divers, D.Sc., F.R.S., and T. Haga, D.Sc.

"Some acids obtained from α-dibromocamphor." By A. Lapworth, D.Sc., and E. M. Chapman.

"Campholytic and isolauronolic acids." By J. Walker and W. Cormack.

"The configuration of the camphoric acids." By J. Walker and J. K. Wood.

"The constitution of camphoric acid." By J. Walker.

An extra Meeting of the Society will be held on Thursday, March 8th, when a lecture on "**Recent Researches on Nitrification**" will be given by Professor Warington, F.R.S. The Chair will be taken at 8.30 p.m.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 220.

March 1st, 1900. Professor THORPE, F.R.S., President, in the Chair.

Mr. J. W. Anderson was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. Henry Jennings, Marlowes, Hemel Hempstead, Herts; Robert Pettigrew, 50, Cresswell Grove, West Didsbury, Manchester; Geoffrey Surtees Phillpotts, 82, James's Street, Dublin.

Of the following papers, those marked * were read:—

*29. "On pilocarpine and the alkaloids of jaborandi leaves." By H. A. D. Jowett, D.Sc.

On account of the doubts expressed by Kundsen, Merck, and others as to the reliability of the work of Hardy and Calmels on this subject, and the recent conflicting statements of Petit and Polonowsky and of Merck, the author has undertaken a complete study of these alkaloids. The present paper deals with the characterisation of pilocarpine, isopilocarpine (pilocarpidine of Petit and Polonowsky), pilocarpidine and jaborine, with a few preliminary experiments on the constitution of the alkaloid. The results, which are given in detail in the paper, may be briefly summarised as follows:

1. The original papers of Hardy and Calmels are very unsatisfactory, as they contain neither physical constants nor analyses of the products described. In most cases, the author is unable to confirm their results. On the other hand, a satisfactory explanation is afforded of the apparent contradiction between the work of Petit and Polonowsky and that of Merck.

2. The physical constants and description of the salts of pilocarpine, as given by Petit and Polonowsky, are generally confirmed, though in several cases there are slight differences, due probably to the use of purer material by the author.

3. The acid character of pilocarpine has been investigated and the previous work of Hardy and Calmels on this subject corrected.

4. The existence of a base, isomeric with pilocarpine, and produced from it by the action of heat or alkali, as previously stated by Petit and Polonowsky, is confirmed. As this base is isomeric with and bears a close relation to pilocarpine, it is proposed to call it isopilocarpine, as the term pilocarpidine, previously used for it, must be retained for the product previously described by Harnack under this name. It is shown that isopilocarpine can be distilled unchanged in a vaccuum.

5. Some of the physical constants of isopilocarpine and its salts as given by Petit and Polonowsky are confirmed, and others corrected.

6. Proof is given of the existence of isopilocarpine in jaborandi leaves and in the pilocarpine nitrate of commerce.

7. The existence of the pilocarpidine of Harnack and Merck and their statements regarding its composition are confirmed. Some of the salts of the base are described.

8. The absence of pilocarpidine in the pilocarpine nitrate of commerce and in the varieties of jaborandi leaves at present in the market is proved.

9. The jaborine of commerce is shown to be a mixture of isopilocarpine, pilocarpidine, and a trace of pilocarpine with colouring matter. No evidence has been obtained of the existence of an alkaloid with the properties of jaborine, or of any other than those described in this paper.

10. Several experiments on the constitution of pilocarpine have been repeated, and the results of Hardy and Calmels corrected.

Further experiments on this subject are in progress.

The author has been unable to obtain any evidence confirmatory of the constitutional formula which was proposed by Hardy and Calmels and widely adopted.

DISCUSSION.

Mr. **KINGZETT** referred to his work on pilocarpine, which was communicated to the Society in 1876. He then proposed for this alkaloid the formula $C_{23}H_{35}N_4O_4$, and although this formula had been modified by later workers to $C_{11}H_{16}N_2O_2$, which was also adopted by Dr. Jowett, he still adhered to the formula he had originally suggested, because it was based on several concordant analytical results.

Professor **DUNSTAN** said that our knowledge of the chemistry of pilocarpine and the alkaloids of jaborandi was in a very uncertain state, and he was glad to find that Dr. Jowett had commenced its careful revision. The alleged existence of jaborine, an alkaloid antagonistic to pilocarpine, had long been a difficulty in the medicinal employment of this drug. Dr. Jowett appeared to have shown good grounds for the conclusion that no such alkaloid as jaborine exists in the plant, and he had made a serious criticism of the generally accepted results and conclusions of Hardy and Calmels.

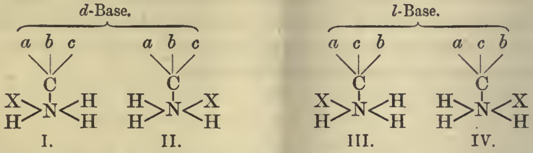
*30. "Isomeric partially racemic salts containing quinquevalent nitrogen."

Hydrindamine bromocamphorsulphonates, chlorocamphorsulphonates and *cis*-π-camphanates. By F. Stanley Kipping, Ph.D., D.Sc., F.R.S.

On continuing the investigation of the isomeric hydrindamine bromocamphorsulphonates already briefly described (*Proc.*, 1899, **15**, 172), it has been found that both compounds, when decomposed by barium hydroxide, yield a base identical with externally compensated hydrindamine. It is proved that the optical inactivity of the base is not due to racemisation having occurred, hence the formation of the two bromocamphorsulphonates cannot be attributed to a resolution of the base into its enantiomorphous components. As to the possibility of the existence of two isomeric forms of bromocamphorsulphonic acid, it is shown that the acid in each salt is the same. Hence it is concluded that the isomeric hydrindamine bromocamphorsulphonates are both partially racemic salts.

The specific rotations of these salts are different in alcoholic solutions of equal concentration; their specific rotations in 1 per cent. aqueous solutions are, for the more sparingly soluble α-salt $[\alpha]_D = +60°$, and for the β-salt $[\alpha]_D = +49·7°$, hence the molecular rotations are $[M]_D = +266·5°$ and $[M]_D = +220·5°$ respectively. As the molecular rotation of bromocamphorsulphonic acid, calculated from the determinations of Walden (*Zeit. phys. Chem.*, 1894, **15**, 196) and from data given in the paper is $+270°$, the low molecular rotation of the β-salt might be taken to indicate either the existence of an isomeric form of bromocamphorsulphonic acid or the presence of lævorotatory hydrindamine. It is shown that as the salt in question is composed of *d*-hydrindamine α-bromocamphorsulphonate and *l*-hydrindamine α-bromocamphorsulphonate, which salts have probably widely different specific rotations in a non-dissociated condition, the apparently abnormal molecular rotation of the β-salt may be attributed to incomplete ionic dissociation.

The following is the explanation of this form of isomerism suggested by the author; it is equally applicable to all the other cases of isomerism of this kind which he has observed. When an externally compensated base combines with an optically active acid, four different salts may be produced, as the following formulæ indicate:



Of these four compounds, no two are mirror images, but as the relation between I and IV, on the one hand, and II and III, on the other, would probably be that of mirror images if the group X were not enantiomorphous, it may be presumed that I and IV would be formed in equal quantities, and might unite to form a partially racemic salt; the isomeric partially racemic salt would be similarly produced from II and III.

Externally-compensated hydrindamine unites with chlorocamphorsulphonic acid to form unequal quantities of two salts which are isomeric when anhydrous, but which are usually differently hydrated. The more sparingly soluble α-salt, which is produced in by far the larger quantity, crystallises from water in opaque, very slender prisms, whereas the β-isomeride is usually deposited in more transparent and compact prisms.

The relationship between these two salts is analogous to that of the compounds above described, but the β-salt differs from the corresponding salt of the bromo-acid, as it exists in two differently hydrated forms, one of which is indistinguishable in appearance from the α-salt. The conditions which determine the formation of one or other variety of the β-salt are not yet known with certainty.

The α- and β-compounds are both partially racemic salts which are not convertible the one into the other by ordinary solvents, but by repeatedly evaporating a solution of the β-salt with externally-compensated hydrindamine, the α-isomeride is obtained.

The specific rotations of the isomerides in alcoholic solution are practically identical, but when dissolved in water, and especially in chloroform, different values are obtained. Determinations in approximately 1 per cent. aqueous solutions gave the following average results: for the α-salt $[\alpha]_D = +47°$, $[M]_D = +188°$; for the β-salt $[\alpha]_D = +50{\cdot}5°$, $[M]_D = +202°$.

The molecular rotation of chlorocamphorsulphonic acid was found to be $[M]_D = +189°$, so that the molecular rotations of the partially racemic salts are practically identical with the values they might be expected to give under the above conditions. The two differently hydrated forms of the β-salt were found to have the same specific rotation when calculated for the anhydrous salt.

When externally-compensated hydrindamine is neutralised with *cis*-π-camphanic acid, unequal quantities of two isomeric anhydrous salts are obtained. The more sparingly soluble α-compound melts at about 192°, the isomeric β-salt at about 172°; when crystallised from water or other solvents, both salts are deposited in very slender prisms practically identical in appearance. The base liberated from either of these salts by barium hydroxide is optically inactive, and as each salt, when directly decomposed by strong hydrochloric acid, gives optically inactive hydrindamine hydrochloride, it is clear that the two salts do not correspond with the two enantiomorphous hydrindamines, but that both are partially racemic substances.

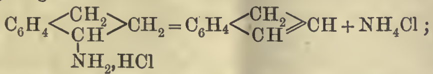
The β-salt may be converted into the α-form by evaporating its aqueous solution with externally compensated hydrindamine, which seems to indicate that the relation between these two salts is similar to that between the isomeric salts of chloro- and bromo-camphorsulphonic acids from which they differ in undergoing hydrolytic dissociation, and this leads to other differences in behaviour, such as the conversion of the one salt into the other in aqueous, and apparently also in alcoholic solution, rendering their separation and the determination of their properties a matter of some difficulty.

Determinations of the specific rotations of these salts in solution in methyl alcohol showed wide variations; different preparations of the α-salt, all melting at the same temperature, gave values for $[\alpha]_D$ varying from $-2°$ to $+20°$, and in the case of β-salt from $-6°$ to $-10°$. By repeated fractional crystallisation, these values were considerably raised, the greatest rotation for the α-salt being $[\alpha]_D = +24°$, and for the β-salt $[\alpha]_D = -20°$.

In solution in methyl alcohol, the rotation of the α-salt is very low at first, being $[\alpha]_D = +5°$ a few minutes after solution; after 45 minutes, it rises to $[\alpha]_D = 24°$, at which it seems to remain constant. The cause of this change is not clear, as the β-salt, in other respects so similar, does not show it. In dilute aqueous solutions, both salts have practically the same rotation, $[\alpha]_D = -16°$, and the molecular rotation calculated from determinations in 1 per cent. aqueous solutions is $[M]_D = -53°$ approximately, a value agreeing fairly well with that obtained for *cis*-π-camphanic acid from an examination of its piperidine salt and of its solution in dilute aqueous ammonia.

*31. "New syntheses of indene." By F. Stanley Kipping, Ph.D., D.Sc., F.R.S., and Harold Hall, A.I.C.

In the course of some work connected with α-hydrindamine, it was found that the hydrochloride of this base is readily decomposed when heated, giving a distillate of indene, and a residue of ammonium chloride,



$$C_6H_4\left<\begin{array}{l}CH_2\\ \underset{NH_2,HCl}{\underset{|}{CH}}\end{array}\right>CH_2 = C_6H_4\left<\begin{array}{l}CH_2\\ CH\end{array}\right>\!\!\geqslant CH + NH_4Cl\,;$$

the reaction seems to take place almost quantitatively, and affords the most convenient method yet known for the preparation of this unsaturated hydrocarbon. Trimethylhydrindamine iodide undergoes a similar decomposition when it is heated, yielding indene and trimethylamine hydriodide. The indene obtained by either of these methods is identical with the hydrocarbon isolated from coal-tar by Krämer and Spilker, and also with that obtained by Perkin and Reváy by the distillation of hydrindenecarboxylic acid (*Trans.*, 1894, 66, 228). The identity of all three preparations was established, the differences between synthetical and coal-tar indene observed by Perkin and Reváy (*loc. cit.*) being doubtless due to the presence in the latter of impurities which they were unable to remove.

Trimethylhydrindamine iodide, $C_9H_9N(CH_3)_3I$, is obtained when hydrindamine is treated with methyl iodide at ordinary temperatures; it crystallises well, is dimorphous, and melts at about 190°.

It seems probable that the reactions described above will also occur in the case of the hydrochlorides of other aromatic partially reduced bases, and experiments will be made to test this.

*32. "Potassium nitrito-hydroximidosulphates and the non-existence of dihydroxylamine derivatives." By E. Divers and T. Haga.

Potassium nitrite forms crystalline compounds with the normal, the 2/3 normal, and the 5/6 normal potassium hydroximidosulphates, all readily decomposed by solution in water, but recrystallisable from sufficiently concentrated solutions of potassium nitrite or of this salt and some potassium hydroxide. Their formulæ are $KNO_2,2K_3NS_2O_7,4OH_2$;

$$KNO_2,K_2HNS_2O_7\,;\ 7KNO_2,2K_5H(NS_2O_7)_2,3OH_2\,;$$
$$3KNO_2,K_5H(NS_2O_7)_2,OH_2\,;\ 7KNO_2,3K_5H(NS_2O_7)_2.$$

The discovery of these salts has enabled the authors to destroy what little evidence there was for the existence of *dihydroxylamine* compounds, two of which have been described by Raschig. One of these he treats as being dipotassium monosulphonated dihydroxylamine, $\begin{matrix}HO\\KO\end{matrix}>NSO_3K$, and the other, more easily obtained, as the anhydro-compound of this with potassium monosulphonated dihydroxylamine,' $\begin{matrix}HO\\KSO_3\end{matrix}>NON<\begin{matrix}OK\\SO_3K\end{matrix}$. The authors have followed Raschig's methods pretty closely and with a sufficient degree of success, and have found his preparations indistinguishable from synthetically prepared compounds, somewhat impure, of nitrite with the 5/6 normal hydroximidosulphate, and the 2/3 normal hydroximidosulphate respectively. According to them, the anhydro-'dihydroxylamine' compound was $KNO_2,K_2HNS_2O_7$, whilst the other was impure $3KNO_2,K_5H(NS_2O_7)_2,OH_2$. Two other salts prepared by Raschig, which have figured respectively as an isomeride of Pelouze's hyponitrososulphate and as an isomeride of the 5/6 normal hydroximidosulphate, are considered by the authors to be also only impure nitritohydroximidosulphates.

*33. "Identification and constitution of Fremy's 'sulphazotised salts of potassium.'" By E. Divers and T. Haga.

By treating a solution of potassium nitrite and hydroxide with sulphur dioxide, Fremy in 1845 obtained a series of salts, and by their hydrolysis or oxidation, other salts, all sulphonated derivatives of nitrous acid. The constitution of several of these has remained undetermined; attempts to reproduce some of them have failed to such an extent as to make even their existence doubtful. The authors have been fairly successful in obtaining Fremy's results, and with the help of the knowledge summarised in the preceding abstract, are able to express the constitution of his salts with confidence. His *sulphazate*, which neither Claus nor Raschig succeeded in obtaining, was made without difficulty by following Fremy's directions. It is the potassium nitrito-2/3-normal hydroximidosulphate partly converted, by treatment with alkali, into the normal hydroximidosulphate. His *sulphazite* is the nitrito-5/6-normal hydroximidosulphate of which the formula is given in the preceding abstract. His *metasulphazate* is described as a jelly, which on pressure in a cloth became waxlike. The authors have obtained a salt in fine, silky fibres in all other respects apparently identical with that of Fremy, and this proved to be potassium nitrito-normal hydroximidosulphate, mixed with a little normal hydroximidosulphate. His *metasulphazotate*, as obtained by the authors, proved to be the potassium nitrito-2/3-normal hydroximidosulphate, mixed or combined with a little normal hydroximidosulphate. The constitution of Fremy's *basic* and *neutral sulph-*

azotates, sulphazidate, sulphammonate, and *sulphamidate* have been already determined, whilst his *sulvhazilate* and *metasulphazilate* appear to have the formulæ $\mathrm{ON{\vdots}(SO_3K)_2}$ and $\mathrm{ON{\vdots}(SO_3K)_3}$.

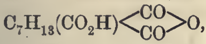
*34. "Some acids obtained from α-dibromocamphor." By Arthur Lapworth and Edgar M. Chapman.

Camphonic acid is the name the authors propose for the acid obtained by hydrolysing α-monobromocampholid (compare Forster, *Trans.*, 1896, **69**, 51). It has the formula $C_{10}H_{16}O_3$, crystallises from ethyl acetate in prisms melting at 194°, and appears to be dimorphous. It has all the properties of a ketonic acid, a fact which shows conclusively that α-monobromocampholid contains the group $-\underline{\mathrm{CBr}-\cdots\cdots\mathrm{CO{\cdot}O}}$. The *oxime*, $\mathrm{CO_2H{\cdot}C_9H_{15}{:}N{\cdot}OH}$, forms slender needles melting at 125—127°; the *semicarbazone*, $\mathrm{CO_2H{\cdot}C_9H_{15}{:}N_2H{\cdot}CO{\cdot}NH_2}$, crystallises in flattened needles which melt and decompose at 222—223°. The *phenylhydrazone* and p-*bromophenylhydrazone* were obtained as colourless, pulverulent substances, which yielded well-characterised sodium salts.

Dibromocamphonic acid, $\mathrm{C_9H_{13}OBr_2{\cdot}CO_2H}$, is obtained on adding bromine to a solution of camphonic acid in chloroform; it melts and decomposes at 144°. *Monobromocamphonolactone*, $\underline{\mathrm{C_9H_{12}OBr{\cdot}CO{\cdot}O}}$, is formed when the sodium salt of the dibromo-acid is boiled with water; it crystallises in glistening needles or prisms melting at 110—111°. *Tribromocamphonolactone*, $\underline{\mathrm{C_9H_{11}OBr_3{\cdot}CO{\cdot}O}}$, produced by gently warming dibromocamphonic acid with excess of bromine, melts at 166—167°.

The formation of a tribromolactone from camphonic acid, taken in conjunction with the rest of the evidence relating to the derivatives of camphorenic acid, shows, with some degree of probability, that bromocamphorenic acid has the formula $\mathrm{CH}{<}\begin{matrix}\mathrm{CH_2{\cdot}CMe_2}\\\mathrm{CBr{-}CH_2}\end{matrix}{>}\mathrm{CMe{\cdot}CO_2H}$, and not $\mathrm{CH}{<}\begin{matrix}\mathrm{CBr{\cdot}CMe_2}\\\mathrm{CH_2{-}CH_2}\end{matrix}{>}\mathrm{CMe{\cdot}CO_2H}$, for which a preference has been expressed by one of the authors (*Trans.*, 1899, **75**, 1139).

Camphonic acid unites with hydrocyanic acid, and on treating the product with hydrochloric acid, two new *acids*, $\mathrm{C_9H_{15}}{<}\begin{matrix}\mathrm{CO_2H}\\\mathrm{CO{\cdot}O}\end{matrix}$ and $\mathrm{C_9H_{15}(OH)}{<}\begin{matrix}\mathrm{CO_2H}\\\mathrm{CO_2H}\end{matrix}$, are obtained. The former crystallises in long needles melting at 144—145°, the latter forms orthorhombic plates melting, with formation of an anhydride, at 207°, and cannot be obtained by hydrolysing the lactonic acid.

Homocamphoronic acid is rapidly attacked by bromine at 140°, but the product is nearly free from bromine, and is probably a mixture of lactonic acids. *Trimethyl homocamphoronate*, $C_7H_{13}(CO_2Me)_3$, was obtained on treating the acid with phosphorus pentabromide and bromine, and subsequently pouring into methyl alcohol; it boils at 305—308° under atmospheric pressure. *β-Anhydrohomocamphoronic acid*,  $C_7H_{13}(CO_2H){<}\genfrac{}{}{0pt}{}{CO}{CO}{>}O$, was obtained on allowing anhydrohomocamphoronic chloride to absorb moisture; it crystallises in well-formed plates or prisms melting at 128—129°; on treatment with aniline or *p*-toluidine, it affords an anilinic and a *p*-toluidinic acid identical with the substances obtained from the ordinary anhydro-acid. Camphononic acid could not be made to unite with hydrocyanic acid, remaining unaltered after several months' contact with the anhydrous acid. The *oxime* of camphononic acid, $CO_2H\cdot C_8H_{13}\colon N\cdot OH$, forms prisms melting at 178—180°; when warmed with sulphuric acid, it appears to undergo structural change, but the product affords camphoronic acid on oxidation.

By adding bromine to a solution of camphononic acid in chloroform, a *compound*, $C_8H_6Br_4$, is obtained, which crystallises in lustrous needles or prisms melting at 77—78°. It is probably a tetrabromoxylene.

*35. "Spectrographic studies in tautomerism. The absorption curves of the ethyl esters of dibenzoylsuccinic acid." By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.

Knorr (*Annalen*, 1896, **293**, 70) describes three varieties of the ethyl ester of dibenzoylsuccinic acid. Two of these show exactly similar chemical reactions while they differ widely from one another in their solubility, melting points, and other physical properties. Knorr regards these bodies as stereoisomeric modifications of the "keto" form of the ester. The third ester differs from the two already referred to in its chemical as well as in its physical properties, and is regarded by Knorr as one of the three possible stereoisomeric modifications of the "enol" ester, or possibly as a mixture of the three modifications. His conclusions, which are based on purely chemical grounds, have been confirmed by the spectrographic examination.

Stereoisomerides, so far as they have been investigated, have shown no differences in the curves of molecular vibrations drawn from their absorption spectra, whereas substances having different constitutional formulæ have invariably different spectra. On applying this test to the ethyl esters of dibenzoylsuccinic acid, it was found that the "enol" ester gave a totally distinct spectrum from the "keto" esters, whilst the spectra of the "keto" esters were indistinguishable from one another. The amount of general absorption caused by the "enol" ester is greater than that produced by the "keto" esters, and while all the esters exhibit selective absorption, the absorption band of the "enol" ester occupies a totally different position from the band of "keto" esters and is much less persistent.

The result of this investigation exemplifies the value of the spectrographic method, and shows how it might be applied with advantage to the investigation of similar cases of isomerism, either as a guide to the chemical investigation or to confirm the conclusions drawn therefrom, especially when any doubt arises as to whether the isomerides have a different constitution, or merely differ in the arrangement of the atoms in space.

*36. "The curves of molecular vibrations of benz-antialdoxime and benz-synaldoxime." By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.

Benz-antialdoxime and benz-synaldoxime give identical curves of molecular vibrations. Ethereal solutions of the two substances were examined. A layer of either solution 25 mm. thick, containing 1 milligram-molecule in 100 c.c. of pure absolute ether, cut off all rays beyond $^1/\lambda$ 3323 ($\lambda = 3009$).

In a layer 1 mm. thick of a solution containing 1 milligram-molecule in 500 c.c. of ether, the spectrum is continuous to $^1/\lambda$ 3638 ($\lambda = 2748$), an absorption band making its appearance between $^1/\lambda$ 3638 ($\lambda = 2748$) and $^1/\lambda$ 4321 ($\lambda = 2314$), which is still discernible in a layer 1 mm. thick of a solution containing 1 milligram-molecule in 2500 c.c. of ether.

37. "On campholytic and isolauronolic acids." By James Walker and William Cormack.

A concentrated solution of potassium ortho-methyl camphorate yields methyl isolauronolate on electrolysis, and the purified isolauronolic acid obtained from this substance is optically inactive. The isolauronolic acid prepared from the campholytic acid of electrolysis is also without optical activity.

When campholytic acid is treated with fuming hydrobromic acid at the ordinary temperature, it speedily solidifies, forming the hydrobromide $C_8H_{14}Br \cdot CO_2H$, which melts with decomposition at about 100°, and is identical with the substance obtained by Noyes. Isolauronolic acid is attacked much more slowly by fuming hydrobromic acid, but eventually forms the same hydrobromide as campholytic acid. This hydrobromide, on treatment with alkali, decomposes according to the equations,

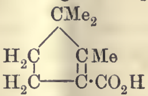
$$\underset{\text{Hydrobromide of Campholytic acid.}}{C_8H_{14}Br{\cdot}CO_2H} + 2NaOH = \underset{\text{Sodium campholytate.}}{C_8H_{13}{\cdot}CO_2Na} + NaBr + 2H_2O.$$

$$C_8H_{14}Br{\cdot}CO_2H + 2NaOH = \underset{\text{Isolaurolene.}}{C_8H_{14}} + NaBr + NaHCO_3 + H_2O.$$

These reactions serve to show that campholytic acid is an $\alpha\beta$-unsaturated acid, and that the bromo-acid melting at about 100° is its true hydrobromide. By means of them, isolauronolic acid may be transformed into campholytic acid, which, together with the isolaurolene obtained at the same time, is optically inactive.

When a more dilute hydrobromic acid is allowed to remain in contact with isolauronolic acid for a long time, a bromo-acid, $C_8H_{14}Br{\cdot}CO_2H$, is obtained which melts at 132° without decomposition. This is the true hydrobromide of isolauronolic acid, for on treatment with alkali this acid is regenerated from it.

The authors consider campholytic and isolauronolic acids to be stereoisomeric, their structure being best represented by the formula



,

derived from the Perkin-Bouveault formula for camphoric acid.

38. "The configuration of the camphoric acids." By James Walker and J. K. Wood.

l-Isocamphoric acid, prepared from *d*-camphoric acid by Marsh's method, has the dissociation constant $K = 0{\cdot}00160$ at 25°. When boiled with alcohol and a small quantity of sulphuric acid, it yields *ortho-ethyl* l-*isocamphorate*, m. p. 73·5°, $K = 0{\cdot}00065$, $[\alpha]_D = -46{\cdot}8$ for 10 per cent. solution in absolute alcohol. *Diethyl* l-*isocamphorate* i most easily prepared by heating dipotassium *l*-isocamphorate with excess of ethyl bromide in presence of ethyl alcohol for 5 hours at 100°, when a theoretical yield is obtained. It is an oil for which $[\alpha]_D = -50{\cdot}4°$ for 10 per cent. solution in absolute alcohol. *Allo-ethyl* l-*isocamphorate* is prepared by the half-saponification of the diethyl salt with the calculated quantity of alcoholic potash. It is a very viscous liquid, having $[\alpha]_D = -22{\cdot}9°$ for 10 per cent. solution in alcohol.

It is generally agreed that the molecule of camphoric acid contains two dissimilar asymmetric carbon atoms, which are links in a closed chain, and have attached to them the ortho- and allo-carboxyl groups respectively. On electrolysis of potassium allo-ethyl *d*-camphorate, an ethereal product is obtained, the lowest boiling portions of which have only the allo-carboxyl group and the allo-asymmetric carbon atom, the ortho-asymmetric carbon atom having lost its asymmetry by the removal of the ortho-carboxyl group. This lowest boiling fraction has a strong positive rotation, namely $[\alpha]_D = +29{\cdot}8°$, which must be due to the allo-asymmetric carbon atom. If now the allo-asymmetric carbon atom of *l*-isocamphoric acid has the opposite configuration to that of *d*-camphoric acid, the rotation of the corresponding fraction from the ethereal product of electrolysis of potassium allo-ethyl *l*-isocamphorate should be of the same dimensions but of opposite sign, that is, it should be strongly negative. The rotation of the substance actually produced is, however, strongly positive, namely $[\alpha]_D = +20{\cdot}9°$, although the original substance and the impurities in the low boiling fraction have a large negative rotation. It appears, therefore, that the allo-asymmetric carbon atoms in *d*-camphoric acid and *l*-isocamphoric acid have the same configuration, and that the ortho-asymmetric carbon atoms have opposite configurations.

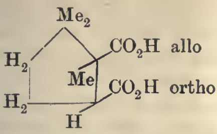
Assuming the configuration RR′ for ordinary camphoric acid, we can represent the configuration of all the camphoric acids by the following scheme :

	d-Camphoric.	*l*-Camphoric.	*d*-Isocamphoric.	*l*-Isocamphoric.
Ortho......	R	L	R	L
Allo	R′	L′	L′	R′

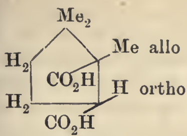
39. "The constitution of camphoric acid." By James Walker.

The Perkin-Bouveault formula for camphoric acid is considered by the author as the most satisfactory hitherto proposed. It represents camphoric acid as a derivative of succinic acid, and thereby accounts in a simple manner for the nature of the unsaturated compounds obtained by electrolysing the sodium alkyl salts of camphoric acid. In particular, the formulæ derived from it for campholytic and isolauronolic acids represent these substances as *αβ*-unsaturated acids without an asymmetric carbon atom, in accordance with their chemical behaviour and optical inactivity. Perkin's second formula and Bredt's formula, which represent camphoric acid as a derivative of glutaric acid, not only fail to explain the electrolytic production of campholytic and isolauronolic acids, but represent these acids as having an asymmetric carbon atom and therefore essentially active. Analogy and experiment alike exclude the assumption of a possible racemism.

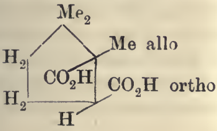
The configuration of the camphoric acids on the basis of the Perkin-Bouveault formula is as follows :



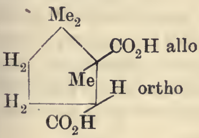
d-Camphoric.



l-Camphoric.



d-Isocamphoric.



l-Isocamphoric.

The dissociation constant of camphoric acid, which seems to be very small for a derivative of succinic or glutaric acid, is shown to be only apparently abnormal. The rise in the constant of succinic and glutaric acids when hydrogen is replaced by alkyl, is due to the approximation of the carboxyl groups, and is not the primary effect of the substitution. If the molecule acquires rigidity by ring formation or multiple linking, this approximation is prevented, and the primary effect of the substitution is observed, which is in general a diminution of the constant, as in monocarboxylic acids. It is therefore to be expected that the dissociation constant of camphoric acid, which has one tertiary and one secondary carboxyl, should be less than that of succinic or glutaric acids, which have two primary carboxyls. The very small values of the monocarboxylic acids derived from camphoric acid confirm this view.

40. "On the presence of invertase in plants of the Gramineæ. I." By James O'Sullivan.

The difficulty of extracting invertase from the living cells of plants which were proved to contain it was the first point considered. This was overcome in the following manner. Portions of the roots, culms and leaves of wheat, oats, and maize plants at various stages of growth, after being well washed with chloroform water, were digested in the cold, and at 49—50°, for different lengths of time, with a cane-sugar solution saturated with chloroform, and the amounts of cane-sugar hydrolysed were determined by the cupric oxide reducing power.

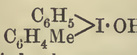
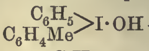
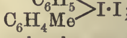
The amounts of cane-sugar hydrolysed are expressed in percentages of the weight of the portions of the plant with which it was digested, and these are taken as expressions for the invertase in those portions.

Check experiments made under similar conditions, (*a*) with cane-sugar solution saturated with chloroform, and (*b*) with chloroform water and portions of the same plants, showed that practically no cane-sugar is hydrolysed, and that the cupric oxide reducing power of the extract is a negligible quantity.

That organisms are not the cause of the hydrolysis of the cane-sugar was proved by "catching up" all the suspended matter in the chloroform water used in washing the portions of the plants, either by means of aluminium hydrate or paper pulp. The aluminium hydrate deposit and the paper pulp, which would contain all the suspended matter—and consequently any organisms present—when digested with similar cane-sugar solutions as in the experiments, gave no more cupric oxide reducing power than the cane-sugar solution and chloroform alone.

41. "Iodonium compounds of the type $IR^{I}R^{II}R^{III}$ and the configuration of the iodine atom." By F. Stanley Kipping, Ph.D., D.Sc., F.R.S., and Harold Peters.

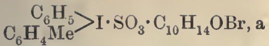
It has been shown by Hartmann and Victor Meyer (*Ber.*, 1894, **27**, 502, 1592) that diphenyliodonium hydroxide, $(C_6H_5)_2I\cdot OH$, is obtained when a mixture of iodosobenzene and iodoxybenzene is shaken with silver oxide and water; the authors have made use of this reaction for the preparation of iodonium bases containing different aromatic radicles.

Phenylparatolyliodonium hydroxide,  $\begin{array}{r}C_6H_5\\C_6H_4Me\end{array}\!>I\cdot OH$, is formed, together with its iodate, from a mixture of iodosobenzene and paraiodoxytoluene, $C_6H_5IO + C_6H_4Me\cdot IO_2 + AgOH =$  $\begin{array}{r}C_6H_5\\C_6H_4Me\end{array}\!>I\cdot OH + AgIO_3$, and is easily isolated in the form of its *iodide*,  $\begin{array}{r}C_6H_5\\C_6H_4Me\end{array}\!>I\cdot I$; this salt crystallises from boiling water in small, almost colourless needles and decomposes at about 153°.

A phenylparatolyliodonium iodide, identical in ordinary properties with the salt just mentioned, is obtained when a mixture of iodosoparatoluene and iodoxybenzene is treated with silver oxide and the product isolated as before.

The identity of these two preparations, if confirmed by further investigation, may be taken as showing that two of the three valencies of the iodine atom are symmetrically situated with respect to the third.

Attempts to resolve the phenylparatolyliodonium base into enantiomorphous components have so far been unsuccessful. When its iodide is treated with silver bromocamphorsulphonate in alcoholic solution, it is converted into *phenylparatolyliodonium bromocamphorsulphonate*,


$\begin{matrix}C_6H_5\\C_6H_4Me\end{matrix}\!>I\cdot SO_3\cdot C_{10}H_{14}OBr$, a compound which separates rom aqueous alcohol in highly lustrous, well-defined crystals, which contain water of crystallisation, and have in consequence an indefinite melting point.

The same salt is obtained from the two iodides which have been prepared by the different methods stated above.

When this phenylparatolyliodonium bromocamphorsulphonate is fractionally crystallised, the various deposits appear to be identical in ordinary and in optical properties; owing to the slight solubility of the salt in cold water, its specific rotation had to be determined in weak aqueous methyl alcohol, three different fractions giving $[\alpha]_D = +45°$, $+45°$, and $+47°$ respectively.

The samples of salt used contained about 3·6 per cent. of water, so that the molecular rotation of the anhydrous substance would be approximately $[M]_D = +283°$; other experiments showed that the presence of methyl alcohol has little effect on the specific rotation, so that, since the molecular rotation of the acid is $[M]_D = +270°$ in aqueous solution, it may be inferred that the iodonium base is optically inactive in all three fractions; unless, therefore, the bromocamphorsulphonate is a partially racemic salt, it may be provisionally concluded that the three iodine valencies, to which the several radicles are attached, are arranged in one plane.

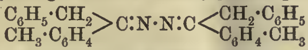
The further investigation of the various points raised in this preliminary note is in progress.

42. "Note on the decomposition of semicarbazones." By F. Stanley Kipping, Ph.D., D.Sc., F.R.S.

In working with various semicarbazones, as, for example, with those of dimethylketohexamethylene, ketotetrahydronaphthalene, ketophenoheptamethylene, it was noticed that a brisk evolution of gas usually occurred when such compounds were melted, but that little if any charring took place. It seemed, therefore, that the decomposition products might be easily isolated, and that their examination would show the nature of the change which had occurred.

The only reference in the literature relating to this subject seemed to be that of Scholtz (*Ber.*, 1896, **29**, 610), who, in attempting to prepare pyridazine derivatives, discovered that the semicarbazones of methylethyl ketone and of other fatty ketones of low molecular weight were decomposed on dry distillation into ketazines and hydrazodicarbonamide.

The author finds that a similar change occurs in the case of the semicarbazones of aromatic compounds; when benzaldehyde semicarbazone, for example, is heated at a temperature above its melting point, it gives an almost theoretical yield of the *azine*, $C_6H_5\cdot CH{:}N\cdot N{:}CH\cdot C_6H_5$, the nature of which was established by direct comparison with the product of the interaction of benzaldehyde and hydrazine.

This formation of azines by the decomposition of semicarbazones seems also to take place in aqueous solution; when, for example, benzylparatolyl ketone is heated on the water-bath with an aqueous alcoholic solution of semicarbazide hydrochloride and sodium acetate, it seems to be converted in the first place into a colourless semicarbazone in the usual manner, but on continued heating the latter gradually changes into a canary-yellow product which is doubtless the *azine*,  $\begin{matrix}C_6H_5\cdot CH_2\\CH_3\cdot C_6H_4\end{matrix}\!>C{:}N\cdot N{:}C<\!\begin{matrix}CH_2\cdot C_6H_5\\C_6H_4\cdot CH_3\end{matrix}$; the latter is readily soluble in chloroform, but only very sparingly so in hot alcohol, and separates from a mixture of these solvents in yellow needles melting at 172—173°.

It may be concluded from these experiments that the formation of azines from aromatic semicarbazones is also a fairly general reaction.

At the next meeting, on Thursday, March 15th, the following papers will be communicated by the authors :—

"The vapour densities of dried mercury and mercurous chloride." By H. Brereton Baker, M.A.

"The preparation of pure hydrobromic acid." By A. Scott, D.Sc., F.R.S.

"A new sulphide of arsenic." By A. Scott, D.Sc., F.R.S.

"The action of iodine on alkalis." By R. L. Taylor.

"The interaction between sulphites and nitrites." By Edward Divers and Tamemasa Haga.

"New polysaccharides: manno-galactan and lævulo-mannan." By Julian L. Baker and Thomas H. Pope.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 221.

March 8th, 1900. Extra Meeting. Professor THORPE, F.R.S., President, in the Chair.

Professor WARINGTON, F.R.S., delivered a Lecture on "Recent Researches on Nitrification."

During recent years, the chief investigations on the character and properties of the nitrifying organisms have been carried out in Winogradsky's laboratory in St. Petersburg, none having been executed in this country. Formerly, investigators had been unable to obtain pure cultures of the organisms; their chemical characters had, however, been studied, as their capacity for growth in a purely mineral solution allowed of their separation from most of the other organisms in the soil. It had been found that the process of nitrification consisted of two distinct pieces of chemical work, effected by two agents, which could be separated from each other; by the first (the nitrous organism), ammonia was converted into a nitrite; by the second (the nitric organism), the nitrite was oxidised to nitrate. These facts were first ascertained at Rothamsted.

To isolate the nitrous organism from soil, Winogradsky commences by a series of cultures in an inorganic solution containing an ammonium salt and the ash constituents of plant food. From this solution, cultivations on solid media are started. For some years, silica jelly was employed, but Oméliansky now prefers plates of magnesia-gypsum saturated with the mineral solution already mentioned. To isolate the nitric organism, the preliminary cultures are made in a solution containing sodium nitrite and ash constituents. As a solid medium, purified agar, with nitrite and ash constituents, is made use of. The fermentable constituents of the agar have been previously removed by Beyerinck's method.

Winogradsky has examined soils from many parts of the world. He finds but one nitrous and one nitric organism in any soil. The nitric organism is everywhere the same species. The nitrous organism may vary. In Europe, N. Africa, and parts of Asia, the same species occurs, with variations in size, and in tendency to adopt a zoeglœa or motile condition; the latter condition displays the greater chemical energy. The nitrous organism from Java is a distinct species, having an extraordinarily long flagellum. The organism from S. America and Australia is generically different; it is a giant coccus. A few other investigators have described different nitrifying organisms, but the evidence adduced has in some cases proved erroneous, and is in other cases as yet insufficient to warrant its acceptance.

Winogradsky had proved by quantitative experiments that the nitrous organism derives its carbon from carbonic acid; the nitric organism possesses the same power. As both organisms flourish in darkness, the energy necessary for the construction of organic matter out of carbon dioxide and water is apparently derived from the oxidation, respectively, of ammonia or a nitrite. Later experiments have shown that the carbonic acid is, in every case, probably taken from a supercarbonate. The nutrition of the bacteria which exist with the nitrifying organisms in a mineral solution requires further study. Stutzer states that his hypomicrobium grows in a mineral solution, and needs carbonic acid for its nutrition, yet possesses no nitrifying power; its source of energy requires explanation.

The refusal of the nitrifying organisms to grow on gelatin, and on most organic media, is well known. Winogradsky and Oméliansky have lately studied the influence of various kinds of organic matter on the nitrifying process. The presence of 0·5 of glucose in 1000 of liquid is sufficient to retard the action of both the nitrous and nitric organism, while about 2 per 1000 entirely prevents nitrification. Glucose has thus as great an influence upon the nitrifying organisms as phenol has on ordinary bacteria. Of simpler forms of organic matter, as sodium acetate, a much larger quantity is required to hinder nitrification.

The influence of ammonia in preventing the action of the nitric organism is very remarkable; 5 parts per million was sufficient to retard its action, and 150 parts per million prevented it altogether, a proportion which is comparable with an effective dose of mercuric chloride. It seems, however, probable that an increase in the quantity and energy of the nitric organism enables it to bear a somewhat greater quantity of ammonia.

It appears from careful trials that the nitrifying organisms are without action upon nitrogenous organic matter; even methylamine is unaffected by them. For nitrification of organic matter to take place, the aid of other organisms is necessary to decompose it and bring the nitrogen into the form of ammonia. The behaviour of the nitrifying organisms towards organic matter and ammonia is of great practical importance.

The lecture was illustrated by lantern slides, and by a number of specimens of pure cultures on solid media, sent by Professor Winogradsky from St. Petersburg. The principal publications referred to will be found in *Trans. Chem. Soc.*, 1891, **59**, 484; *Archives des Sciences biologiques*, **1** and **7**; *Cent. Bakt.*, 1899, **2**, 652; *Mitt. Landw. Institute Breslau*, **1**, 75; **2**, 197; *Compt. rend.*, 1899, **128**, 566.

On the motion of Sir W. T. THISTLETON-DYER, seconded by Dr. HUGO MÜLLER, a vote of thanks was passed to Professor Warington for his lecture.

March 15th, 1900. Professor THORPE, F.R.S., President, in the Chair.

Messrs. A. H. Bennett, A. W. Harvey, and H. W. Cook were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Heinrich Rowland Beringer, 11, Dolcoath Road, Camborne; John Richard Brooke, 20, Aberdeen Park, Highbury, N.; Arthur Brand Chater, 65, Queen Street, Brisbane; Nicholas Cullinan, Risca, Monmouthshire; John Cussons, 4, Mount Pleasant, Portmadoc; William Donald, Saltcoats, Ayrshire; Frederic Richard Ellis, 15, Elton Road, Bishopston, Bristol; Thomas FitzGibbon, 1, Clyde Cottages, Ilford; James Herbert Haynes, 73, Brynland Avenue, Bishopston, Bristol; Thomas Lamb Lockhart, Johannesburg, Transvaal.

The following letter, addressed to the President, has been received from Professor van't Hoff, in acknowledgment of the congratulations sent to him by the Officers and Council on the occasion of the celebration, in December last, of the completion of the 25th year of his Doctorate:

CHARLOTTENBURG, *20th February*, 1900.

MY DEAR COLLEAGUE,

Still engaged in answering the congratulations I received on the occasion of my Jubilee, I now come again to those from the Chemical Society of London, which reached me through the kind intervention of you and Professor Dunstan. I pray that you will convey my feelings of gratitude to the Society, which has so recently admitted me as one of its Foreign Members.

I am, yours truly,
J. H. VAN'T HOFF.

Of the following papers, those marked * were read.

*43. "The vapour densities of dried mercury and mercurous chloride." By H. Brereton Baker, M.A.

The vapour density of ammonium chloride has already been shown to be normal when carefully purified and dried (*Trans.*, 1894, **65**, 615; 1898, **73**, 425), pointing to the fact that moisture is necessary for the dissociation of this substance. Experiments have been tried with purified and dried mercurous chloride with the view of finding out if it behaved in a similar way when vaporised. The determinations were made with a specially devised modification of Victor Meyer's apparatus in an atmosphere of nitrogen at 448°. The mean of five determinations gives a vapour density of 217·4. A determination of the vapour density of the undried substance in the same apparatus gave 118·4. Dried mercurous chloride did not give gold amalgam when gold was heated in its vapour. Under the same conditions, the gold amalgam was obtained with the incompletely dried chloride. Very dry mercurous chloride therefore would seem to have the formula Hg_2Cl_2 at 448°.

Similar experiments were made with carefully purified and dried mercury at 448°. The mean of three determinations in an atmosphere of nitrogen was 108·1, so that the molecule of dried mercury is probably monatomic at this temperature.

DISCUSSION.

Mr. D. HOWARD said that prolonged experience in the sublimation of large quantities of mercurous chloride had shown that the presence of vapour of water seemed to determine the corrosive action of the vapour on iron, and that the behaviour of the vapour of the chloride in the comparatively imperfect dryness obtainable on a large scale, suggested a true sublimation rather than dissociation.

Professor DEWAR remarked that it might interest the Society to know that Lord Rayleigh had recently found liquid air to be an effective desiccating agent as compared with phosphorus pentoxide, and that shortly the results of new determinations of the density of hydrogen thus dried would be communicated to the Royal Society.

Professor MCLEOD pointed out that it would be interesting to know the quantity of water which would be sufficient to cause the complete dissociation of the heated mercurous chloride, for if the quantity were known it might be possible to ascertain the mechanism of the change.

*44. "The preparation of pure hydrobromic acid." By A. Scott.

The author recommends the employment of sulphurous acid as a better and more convenient agent for preparing hydrobromic acid from bromine than amorphous phosphorus, even when purified from chlorides as Stas recommends. Almost all samples of phosphorus contain arsenic to a certain extent, and this, by the action of the bromine, becomes arsenious bromide which distils over with the hydrobromic acid, giving rise to arsenites and arsenates in the bromides prepared from acid made in this way.

By distillation two or three times, the hydrobromic acid is easily separated from the sulphuric acid formed at the same time, but it is always safer to add a little barium bromide before the final distillation. The purity of the acid was all that could be desired; this was shown by preparing from it some pure potassium bromide and titrating it against pure silver with all Stas's precautions, when its equivalent was found to be 119·099 ($Ag = 107·93$). Similar determinations with potassium bromide from hydrobromic acid prepared as recommended by Stas (*Œuvres*, 1, 842) and by J. P. Cooke (Squibb's process) (*Proc. Amer. Acad.*, 1881, **17**, 31) gave 119·099 and 119·102 respectively. Stas's own number (mean of 14 experiments) is 119·095.

*45. "A new sulphide of arsenic." By A. Scott.

When phosphorus containing (as it almost always does) small quantities of arsenic is oxidised by nitric acid and the solution boiled down, at a certain degree of concentration the liquid becomes brown provided too much nitric acid has not been used. This brown colour, as has long been known, is due to the separation of metallic arsenic by the reducing action of the phosphorous acid present. If, before the concentration has been carried so far, the liquid be diluted and sulphur dioxide passed into it and then warmed, a yellow precipitate of arsenic trisulphide is obtained, caused by the reduction of the sulphurous acid to hydrogen sulphide by the phosphorous acid. This reaction may be used as a test for arsenates by adding a few drops of phosphorus trichloride to the solution, then some sulphurous acid, and warming, when the yellow precipitate is obtained at once.

If, however, these substances be allowed to react at ordinary temperatures, a dark brown precipitate is obtained which consists almost entirely of a new arsenic sulphide having the formula As_3S. This may be freed from the small quantity of trisulphide usually formed at the same time by repeated treatment with ammonia solution into which a little hydrogen sulphide has been passed. This new sulphide is unattacked by ammonia, colourless ammonium sulphide, or carbon disulphide, but dissolves in yellow ammonium sulphide and is attacked by potash solution, giving a dark brown substance exactly like that obtained by Berzelius by the action of potash solution on realgar.

*46. "The action of iodine on alkalies." By R. L. Taylor.

In the present paper, the author describes experiments using iodine in much stronger solutions—decinormal—sixty times the strength of the aqueous solution previously used by him (*Mem. Lit. & Phil. Soc. Manch.*, 1897, **41**, VIII.). Using Schwicker's method, he finds that if the requisite quantity (or more) of alkali is added to a decinormal solution of iodine and then a bicarbonate *immediately* added, from 88 to 94 per cent. of the iodine is liberated, and therefore that amount of the iodine had reacted with the alkali to form hypoiodite and iodide. By allowing different short intervals to elapse between the mixing of the alkali and iodine and the addition of the bicarbonate, he finds that the hypoiodite decomposes with great rapidity even at the ordinary temperature. The stability of a hypoiodite, in fact, depends upon its dilution, and this accounts for the definite results obtainable with very dilute solutions and the previous failures to obtain satisfactory evidence of the formation of hypoiodite when strong solutions of iodine, or the solid itself, have been used.

The iodine used was in solution in potassium iodide, the only effect of using varying amounts of which was to vary the amount of alkali required to complete the reaction, as might indeed be surmised from the fact that the reaction is a reversible one.

The author concludes that the action of iodine upon alkalies in the cold is always the same in the first instance, namely, the formation of hypoiodite and iodide, and that the hypoiodite decomposes more or less rapidly, according to the concentration, into iodate and iodide.

*47. "The interaction between sulphites and nitrites." By Edward Divers and Tamemasa Haga.

The interaction of a nitrite with sulphurous acid or a sulphite, usually regarded as complicated, is really very simple. Nitrous acid, in the form of nitrous fumes, is entirely taken up by a solution of a pyrosulphite with the production of a two-thirds normal hydroximidosulphate, thus $HONO + (KSO_2)SO_3K = HON(SO_3K)_2$. If the normal sulphite be used, the reaction is $3HONO + 2K_2SO_3 = 2KNO_2 +$

$OH_2 + HON(SO_3K)_2$. Sulphurous and nitrous acids themselves may be used to show the nature of this interaction, and to prove that neither the base of the nitrite nor the sulphite takes any part in the sulphonation. A sulphite does not act on a nitrite in presence of free alkali, and a pyrosulphite ceases to act when it has become the normal sulphite by its action upon the nitrite. The sulphonation of a nitrite requires always an acidic condition of the solution, and the authors maintain that, in every case, it is nitrous acid itself, rather than the nitrite taken, which suffers the sulphonation. Carbon dioxide or an acid carbonate causes a normal sulphite to act slowly upon a nitrite.

The statements of Claus, Berglund, and Raschig, that an alkaline hydroxide is produced in the sulphonation of a nitrite, is disproved by the authors and shown to be due to a misconception of the facts observed.

Sulphur dioxide, passed into a solution of sodium or potassium nitrite and hydroxide, converts the latter into normal sulphite before sulphonation begins; pyrosulphite is then produced much faster than it can be consumed in sulphonating the nitrite, because of the retarding influence of the normal sulphite still present; and finally, when the quantity of the normal sulphite is sufficiently reduced, the pyrosulphite disappears faster than it is formed, leaving hydroximidosulphate as the sole final product. If the normal carbonate be taken in place of the hydroxide, the sulphonation proceeds rapidly with the simultaneous production of acid carbonate and of sulphite over and above what is consumed in forming the hydroximidosulphate, so long as any normal carbonate remains. Finally, the sulphite and acid carbonate are used up with the sulphur dioxide in sulphonating the last portions of the nitrous acid.

As it is nitrous acid itself which undergoes the sulphonation, the nitrite of any base should be capable of being used for the purpose, and the authors have tried with success, not only the nitrites of sodium and potassium, but also those of ammonium, calcium, barium, zinc, mercury (ous), and silver.

*48. "The sym-dipropyl-, sym-di-isopropyl-, and $\alpha\alpha'$-propylisopropyl succinic acids." By William A. Bone and C. H. G. Sprankling.

In continuance of their investigations on the alkyl substituted succinic acids, the authors have prepared those which form the subject of the present communication, and show, contrary to the statement of Auwers (*Annalen*, 1898, **292**, 164), that each exists in two stereoisomeric, inactive forms.

In the case of each acid, each stereoisomeride yields with acetyl chloride *its own* anhydride (liquid) which with aniline yields a characteristic anilinic acid ; each isomeride, on being heated to a high temperature with strong hydrochloric acid under pressure, is to a greater or less extent converted into the opposite form ; *trans*-acids are completely converted into *cis*-anhydrides on being heated with acetic anhydride to 170°.

The paper concludes with a discussion of the dissociation constants of the new acids in relationship to those of other alkyl-substituted succinic acids, special attention being drawn to the very great difference between the values for the *trans*- and *cis*-*s*-diisopropyl acids.

The chief properties of the acids may be thus tabulated :

	Trans.			*Cis.*		
	M. p. Acid.	M. p. Anilinic acid.	Dissociation constant.	M. p. Acid.	M. p. Anilinic acid.	Dissociation constant.
s-Dipropylsuccinic	182—3°	184—5°	0·025	121°	101—2°	0·049
s-Diisopropylsuccinic	226	201—2	0·0108	171	184—5	0·2300
$\alpha\alpha_1$-Propylisopropylsuccinic	192—4	147—9	0·0147	151—2	liquid	0·0295

49. "Manno-galactan and lævulo-mannan; two new polysaccharides." By Julian L. Baker and Thomas H. Pope.

The authors described two new complex carbohydrates, the one obtained from the Indian clearing nut (*Strychnos potatorum*), and the other from the ivory nut (*Phytelephas macrocarpa*). As these carbohydrates are very stable, the authors have been limited almost entirely to a study of the products obtained by their hydrolysis, these being, for the clearing nut substance, galactose and mannose, and for the ivory nut carbohydrate, mannose and another sugar, which, although not isolated as such, exhibits the characters of lævulose. Having regard to the relative proportions of the different sugars obtained, the authors propose to call the first of these substances manno-galactan, and the other lævulo-mannan. They give no colour reaction with iodine, nor could acetyl- or phenylhydrazine derivatives be obtained.

Manno-galactan.—The powdered clearing nuts are extracted with hot dilute aqueous alkali, and the filtered extract precipitated by means of Fehling's solution ; this yields an insoluble, blue, pasty, copper compound, which, after washing, is decomposed with acid, the addition of alcohol to the acid solution then causing the reprecipitation of the carbohydrate. The manno-galactan thus prepared, when dry, is a snow-white, amorphous substance, fairly soluble in cold water and more so in hot; it dissolves readily in dilute caustic alkali solutions. Its composition corresponds with the formula $C_6H_{10}O_5$, and in dilute aqueous solution it has a specific rotation $[\alpha]_D$ at 15° = +74°. After acid hydrolysis $[\alpha]_D$ has a value of about 58·8°, corresponding nearly with the proportion of two parts of galactose to one of mannose. This ratio is supported by the determination of the mucic acid yielded on oxidation with nitric acid. The *dibenzoyl* derivative, $C_6H_8O_5Bz_2$, of the manno-galactan is amorphous and dissolves in benzene, alcohol, and acetic acid, but gives no definite melting point; in a glacial acetic acid solution, its specific rotation $[\alpha]_D = +23°$.

Lævulo-mannan.—As this substance undergoes decomposition in contact with hot aqueous alkali, the extraction of the ivory nut turnings is carried out in the cold, the alkaline liquor being then precipitated by means of Fehling's solution. After separating and washing the copper compound, it is decomposed with hydrochloric acid, and the filtered acid liquid, on standing, deposits a thick, white precipitate, which is soluble in hot water, but on boiling the solution, the insoluble lævulo-mannan separates out. After drying, the lævulo-mannan is obtained as a white, amorphous substance having the composition $C_6H_{10}O_5$, and its specific rotation in dilute alkali $[\alpha]_D = -44·1°$. After hydrolysis with acid, $[\alpha]_D$ becomes +9·5°; this corresponds nearly with the proportion 20 parts of mannose to 1 of lævulose. Approximate determination of the mannose by the hydrazone method shows that at least 90 per cent. of the mixed sugars consists of mannose. The *dibenzoyl* derivative, $C_6H_8O_5Bz_2$, prepared by the Baumann method, is an amorphous substance soluble in benzene, alcohol, and glacial acetic acid, which has in the last-named solvent a specific rotation $[\alpha]_D = -74°$.

50. "Hydrolysis of semicarbazones." By George Young, Ph.D., and Ernest Witham, B.A., B.Sc.

The publication by Kipping of a "note on the decomposition of semicarbazones" (this vol., 63) necessitates a preliminary notice of an investigation on which the authors are engaged. Some time ago, they observed that hydrazodicarbamide gradually disappeared when boiled with water for some days, ammonia and carbon dioxide being evolved. By heating hydrazodicarbamide with water in a sealed tube, they were able to control the hydrolysis, and to obtain a solution the properties of which showed that it contained the first product of hydrolysis, ammonium semicarbazidocarboxylate, $NH_2·CO·NH·NH·CO_2NH_4$. When an aqueous solution of this salt is heated in an open vessel, it rapidly dissociates into ammonia, carbon dioxide, and semicarbazide, the latter being then further hydrolysed.

The authors have studied the hydrolysis of other similarly constituted substances, amongst them benzalsemicarbazone. When boiled with water in a reflux apparatus, benzalsemicarbazone gradually acquires a yellow colour, due to the formation of benzalazine. Heated with water in a sealed tube, the benzalsemicarbazone dissolves to a colourless solution, which yields benzalazine on boiling, or more quickly on addition of sulphuric acid. In both cases, carbon dioxide is evolved. The filtrate from the benzalazine yields a further quantity of that substance on shaking with benzaldehyde.

The formation of benzalazine from benzalsemicarbazone when the latter is boiled with water takes place apparently according to the following scheme :

$$C_6H_5\cdot CH{:}N\cdot NH\cdot CO\cdot NH_2 + H_2O = C_6H_5\cdot CH{:}N\cdot NH\cdot CO_2NH_4.$$
$$C_6H_5\cdot CH{:}N\cdot NH\cdot CO_2NH_4 = C_6H_5\cdot CH{:}N\cdot NH_2 + CO_2 + NH_3.$$
$$2\,C_6H_5\cdot CH{:}N\cdot NH_2 = C_6H_5\cdot CH{:}N\cdot N{:}CH\cdot C_6H_5 + N_2H_4.$$

In the formation of the azine from benzylparatolylketone, quoted by Kipping, the process would doubtless be hastened by the presence of free acetic acid.

The investigation is being extended to the corresponding thio-compounds and to substituted hydrazodicarbamides.

51. "The dissociation constant of azoimide." By Charles Alfred West, A.R.C.Sc.

The dissociation constant of azoimide in aqueous solution was determined some years ago by Ostwald, but no details were ever published. The results obtained by the author agree closely with those of Ostwald, and show that azoimide as an acid approximates to acetic acid. The values of μ, m, and k are as follows :

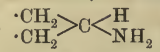
v.	μ.	m.	k.
10	5·38	0·01397	0·0000198
100	15·98	0·0415	0·0000180
1000	45·97	0·1194	0·0000166

52. "Racemisation occurring during the formation of benzylidene, benzoyl and acetyl derivatives of dextro-ac-tetrahydro-β-naphthylamine." By William Jackson Pope and Alfred William Harvey.

On heating dextro-ac-tetrahydro-β-naphthylamine carbonate (*Proc.*, 1899, 15, 170) with benzaldehyde on the water-bath, a product is obtained which by fractional crystallisation is resolved into the inactive benzylidenetetrahydro-β-naphthylamine of Bamberger and Kitscheldt (*Ber.*, 1890, **23**, 876) and *benzylidenedextrotetrahydro-β-naphthylamine*, $C_{10}H_{11}\cdot N\colon CHPh$; the new substance, which is accompanied by about 20 parts of the isomeride, crystallises in aggregates of colourless needles melting at 58—60°, and since it is more soluble than the inactive isomeride, the latter is a true racemic compound. The purest sample obtained of the active substance has $[\alpha]_D = +27\cdot6°$ in a 1 per cent. solution in alcohol.

Benzoylation occurs readily on treating dextrotetrahydro-β-naphthylamine dextro-α-bromocamphorsulphonate by the Schotten-Baumann method, but the product consists almost wholly of the inactive benzoyltetrahydro-β-naphthylamine of Bamberger and Müller (*Ber.*, 1888, **21**, 850), and contains only a very small proportion of *benzoyldextrotetrahydro-β-naphthylamine*, $C_{10}H_{11}\cdot NH\cdot COC_6H_5$; a larger yield of the latter substance is obtained by adding a solution of benzoic chloride in benzene to a solution of dextrotetrahydro-β-naphthylamine in benzene at 0°. The active benzoyl derivative is isolated by fractional crystallisation from alcohol, being more soluble than its inactive isomeride, and forms less than 5 per cent. of the total product. It crystallises in wool-like needles melting at 155—157°, and the highest specific rotation observed was $[\alpha]_D = +58°$ in solution in acetone.

On treating at 0° a solution of dextrotetrahydro-β-naphthylamine in benzene with acetyl chloride dissolved in benzene a mixture of Bamberger and Müller's inactive tetrahydroacenaphthalide with 2 or 3 per cent. of *dextrotetrahydroacenaphthalide*, $C_{10}H_{11}\colon NH\cdot COCH_3$, is obtained; the active component is the more soluble, and may be isolated by fractional crystallisation from benzene. It forms long, colourless needles melting at 104—106°, and the highest specific rotation observed was $[\alpha]_D = +37°$ in a 2 per cent. solution in benzene.

During the conversion of dextrotetrahydro-β-naphthylamine into its benzylidene, benzoyl, or acetyl derivative, all but a very small proportion of the primary base undergoes racemisation, and this racemisation apparently occurs prior to the formation of the final product, because the active derivatives are not racemised by heating at 100° either alone or in solution. Racemisation, as a result of operating upon an amido-group contiguous to an asymmetric carbon atom, does not seem to have been observed before, most of the cases, with rare exceptions, such as that of camphor (Kipping and Pope, *Trans.*, 1897, **71**, 956), being of substances in which a hydroxyl-group is attached to the asymmetric carbon atom, and in which the possibility arises of change from an "enolic" to a "ketonic" form. It is important to note that in the present cases the whole of the material is not racemised, indicating that the asymmetric carbon atom in the group  $\begin{matrix}\cdot CH_2\\ \cdot CH_2\end{matrix}>C<\begin{matrix}H\\ NH_2\end{matrix}$ never becomes separately bound to only three atomic groups at any stage in the substitution.

Work on these and analogous cases is being continued in the hope of obtaining information respecting the mechanism of substitution in trivalent nitrogen compounds.

ANNUAL GENERAL MEETING.

BUNSEN MEMORIAL LECTURE.

The Annual General Meeting of the Society, for the election of Officers and other business, will be held on Thursday, March 29th, at 3 o'clock in the afternoon.

At this meeting the Longstaff Medal will be presented to Professor W. H. Perkin, junr., F.R.S.

In the evening, the Bunsen Memorial Lecture will be delivered by Sir HENRY E. ROSCOE, F.R.S., Vice-President The Chair will be taken at 8.30.

At the next ordinary meeting, on Thursday, April 5th, the following papers will be communicated by the authors.

"The liquefaction of a gas by 'self-cooling.' A lecture experiment." By G. S. Newth.

"Note on partially miscible aqueous inorganic solutions." By G. S. Newth.

"The decomposition of chlorates. Part II." By W. H. Sodeau, B.Sc.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 222.

March 29th, 1900. Annual General Meeting. Professor THORPE, F.R.S., President, in the Chair.

Dr. DYER and Mr. FRISWELL were appointed Scrutators, and a ballot was opened for the election of Officers and Council for the ensuing year, the ballot being closed at the conclusion of the President's address.

In beginning his Address, the President congratulated the meeting on the fact that the Society continues to grow and prosper; the number of its Fellows steadily increases, and their communications continue to add to its dignity and usefulness. Its financial position is no less satisfactory.

The numerical strength of the Society was as follows:—

Number of Fellows, March 29th, 1899		2230
,, ,, since elected		118
,, ,, reinstated by Council		4
		2352
Removed on account of non-payment of two annual subscriptions	15	
Withdrawn	20	
Deaths	25	60
Number of Fellows, March 29th, 1900		2292
Foreign Members		33

The names of those removed were:—Eugen Blume; Rev. J. Campbell; J. E. Foakes; Bertram Hunt; H. Hyatt; J. D. Johnstone; C. L. Kennicott; H. A. Lawrance; W. J. Martin; K. P. McElroy; T. G. Nicholson; J. H. Overton; A. E. Potter; John Provis; J. Wrightson.

The following have withdrawn:—Henry Austin Appleton; Howard Barrett; Claude H. Bater; Richard A. Bush; G. W. Davies; Alfred George Earl; J. M. Fallon; W. A. Greaves; H. Loft Haller; M. Holzmann; A. Wentworth Jones; John Temple Leon; E. W. Lucas; Prosper H. Marsden; Walter George McMillan; T. Ormerod; J. R. Skelton; Edward Smith; Henry J. Staples; Claude T. Vautin.

The following have died:—Joshua Buchanan; Robert Wilhelm Bunsen; Kanny Lall Dey; J. B. Edwards; Sir Edward Frankland; Charles Friedel; William Harkness; John F. Hodges; John Elias Hughes; Eric H. Jackson; William Marcet; Alexander McDougall; Walter Newton; L. F. Nilson; G. H. Ogston; Robert Oxland; R. T. Plimpton; C. F. Rammelsberg; Henry Charles Reynolds; J. G. F. Richardson; W. H. Richardson; Thomas Glazebrook Rylands; Edward C. Cortis Stanford; Sidney Augustus Sworn; Andrew Taylor; William Thorp; Ferdinand Tiemann; Peter Waage; David Watson; W. Lloyd Williams.

The passing away of so eminent a member of the Society, and of one who played such a leading part in the development of chemistry, as Sir Edward Frankland is no ordinary event in the history both of Science and of the Society, and demands a special reference. The Council have accordingly determined that Sir Edward Frankland's services shall be commemorated in the manner hitherto restricted, with the special exception of the late Professor von Hofmann, to its Honorary Foreign Members; and they have requested his pupil, collaborator, and friend, Professor Armstrong, to give a Memorial Lecture on his life-work in the ensuing autumn.

The names of the deceased Foreign Members are Robert Wilhelm Bunsen, Charles Friedel, Lars Fredrik Nilson, Carl Friedrich Rammelsberg, and Peter Waage.

Bunsen, who was elected a Foreign Member during the first session of the Society, namely, as far back as February 1, 1842, and who was long the *doyen* on the list, died on August 16, 1899, in his 89th year. His friend and pupil, Sir Henry Roscoe, a past President of the Society, has undertaken, at the request of the Council, to commemorate the signal services which Professor Bunsen rendered to physical science

Charles Friedel, Member of the Institute and Professor of Chemistry in the Sorbonne, who was elected a Foreign Member of the Society on May 18th, 1876, died on April 20th, 1899, at the age of sixty-seven. His friend and co-worker, Professor J. M. Crafts, of the Massachusetts Institute of Technology, and a Fellow of this Society, has kindly responded to the invitation of the Council to prepare a Memorial Lecture, which he hopes to be able to deliver on some evening in the latter half of June next.

Lars Fredrik Nilson, Professor of Agricultural Chemistry in the Kongl. Landtbruks-Akademien, Stockholm, and formerly Professor of Analytical Chemistry in the University of Upsala, whose name is specially connected with the chemistry of the so-called rare earths, and who was elected a Foreign Member of the Society on February 2, 1888, died on May 14, 1899, in his 59th year. Professor Otto Pettersson, of the Free University of Stockholm, who was associated with Nilson in most of his work in pure chemistry, has undertaken, in compliance with the wish of the Council, to give the Society an account of the many services which his friend rendered to chemistry, and he hopes to be able to visit London for this purpose in the first week of July next.

Carl Friedrich Rammelsberg, Geh. Reg. Rath. and Emeritus Professor of Inorganic Chemistry in the University of Berlin, who was elected a Foreign Member on May 3, 1866, died on December 28, 1899, in his 87th year. Professor H. A. Miers, of Magdalen College, Oxford, and a Fellow of this Society, has kindly acceded to the wish of the Council to prepare a memorial lecture on the life-work of the veteran mineralogical chemist, which he hopes to deliver to the Society in December next.

Peter Waage, Professor of Chemistry in the University of Christiania, whose name is best known in connection with the studies on chemical affinity which he made in association with his colleague, Professor Guldberg, died on January 13th of this year. He was elected a Foreign Member of this Society on January 20th, 1898.

Since the last Anniversary, 175 communications have been made to the Society, a number greater than in any preceding year. In character, variety, and importance they compare not unfavourably with the contributions of any former period. Abstracts of all these have appeared in the *Proceedings*, and 83 have already been published in the *Transactions*. The volume of *Transactions* for 1899 contains 120 memoirs, occupying 1166 pages; in the preceding year 102 papers were published, occupying 1038 pages.

The volumes for 1899 contain 3617 abstracts of papers, published mainly in Continental journals, occupying 1796 pages, arranged as follows;

	Pages.	No. of Abstracts.
PART I.		
Organic Chemistry	968	1477
PART II.		
General and Physical Chemistry		421
Inorganic Chemistry		417
Mineralogical Chemistry		211
Physiological Chemistry		236
Chemistry of Vegetable Physiology and Agriculture		244
Analytical Chemistry		611
	828	2140
Total in Parts I. and II.	1796	3617

The number of abstracts dealt with in 1899 is 791 more than in the preceding year. All arrears in abstracting have at length been overtaken. The Fellows may now count upon having the monthly *résumé* of contemporary chemical literature brought to their attention as quickly as it is possible to furnish it.

It will have been observed also that the Editor has succeeded in issuing the Journal somewhat earlier in the month than has hitherto been thought possible.

The question of co-operation with other English-speaking Chemical Societies in the preparation of abstracts of foreign chemical literature was referred to in the last Presidential Address. But, although the matter has been considered, the Committee appointed to deal with this question has not yet reported.

637 copies of the 1883–92 Index and 317 of the 1873–82 Index were issued to Foreign Members, Institutions, and to those Fellows who, being entitled to a Free Grant of them, had made application within the prescribed period. 565 of these applications had been received, of which 43 were those of Fellows resident abroad.

The work of compilation of the Collective Index showed the necessity of indexing the annual volumes in a more systematic manner than had been done in the past. For the last four years, the work of indexing the annual volumes has been entrusted to a special staff of indexers under the direction of the Sub-Editor. This plan has worked well as regards uniformity and consistency, but unfortunately it has not been possible, by means of it, to bring out the Annual Index with that promptitude which is desirable. The Index Committee has therefore suggested to the Council the propriety of entrusting the work of indexing to one person, to be responsible, under the direction of the Editor, for the preparation and speedy publication of the work, and the Council has sanctioned the employment, on this work, of Mrs. Dougal, who is already favourably known to the Fellows for the excellent service she rendered the Society in editing the Collective Indexes of its publications since 1873.

The Fellows are aware the Society stocks a certain number of its publications, and the question of the custody and supply of back numbers has received attention. A limited number of sets of the *Memoirs* and *Proceedings* of 1841—7, of the *Quarterly Journal*, 1849—62, and of the First Series of the *Journal* from 1863 onwards are now on sale.

As regards the Library, 790 books have been borrowed, as against 727 last year; and 114 books, 397 volumes of periodicals, and 27 pamphlets have been added, as against 67 books, 285 volumes of periodicals, and 24 pamphlets in the preceding year.

The condition of the Library Catalogue has received attention, and the Council has directed a new Catalogue to be prepared according to a scheme drawn up by the Library Committee; and the work is well advanced under the direction of Mr. Steele, assisted by Miss Morfee.

Grants amounting to £192 have been made in aid of chemical investigation.

The Longstaff Medal has been awarded to Professor W. H. Perkin, F.R.S. In making the presentation, the President said:—

"DR. PERKIN, it gives me a special pleasure to ask you, on behalf of the Chemical Society, to transmit this medal to your son, Professor W. H. Perkin, who, to our great regret, is unable to be here to receive it in person. The Longstaff Medal has been awarded to him for his researches on closed chain compounds of the trimethylene and similar series, and for his recent important syntheses of camphor derivatives.

"The Council desire on making this award to indicate how highly we regard the contributions with which he has enriched our *Transactions*. Under his stimulating influence, the chemical laboratory of the Owens College, and especially that section of it under his more immediate direction, continues, as of old, to furnish a succession of valuable memoirs to English chemical literature. We trust that this activity may long be maintained, and that our Society may continue, as in the past, to enjoy the credit and distinction of disseminating the results of the inquiries to which his fruitful ideas give rise."

During the long vacation, the building has been thoroughly cleaned and redecorated, and certain much needed improvements in the lavatory accommodation and in the sanitary arrangements of the building have been effected.

The accommodation at the disposal of the Society is, however, a matter of growing concern. The meeting-room seats no more than 157 persons, in spite of the increased space which was gained as the results of the alterations in 1892. This is altogether incommensurate with the present numerical strength of the Society, and, as the Fellows well know, considerable inconvenience is occasionally felt owing to the impossibility of finding room for those who wish to attend the meetings. The collection of books is gradually overspreading into every room the Society possesses and such conveniences as the officers have for the discharge of their official business and for the custody of the official records are greatly curtailed by the increasing inadequacy of the space at their disposal.

The Society is indebted to several of its Fellows for additions to its artistic possessions; among these is a bust of Sir Humphry Davy, presented by Dr. Debus, a copy of which in bronze, together with its pedestal, has been given by Dr. Messel; Dr. Atkinson has presented an electrotype medallion of Wöhler, executed by Dr. Hugo Müller, and Sir Henry Roscoe has given some photographic mementoes of his association with Bunsen and the Heidelberg Laboratory.

The Society had the pleasure of congratulating, by a suitable address, Sir George Gabriel Stokes on the occasion of his jubilee as Lucasian Professor of Mathematics, and it has since received from the University of Cambridge an exemplar of the medal which was struck in commemoration of that event.

Congratulations have also been sent to Professor Emil Fischer and Professor van't Hoff on the twenty-fifth anniversaries of their doctorates, of which acknowledgments, already published in the *Proceedings*, have been received.

The remainder of the address was devoted to a review of the progress of chemical science from the beginning of the century to the date of the formation of the Society.

Sir H. ROSCOE, F.R.S., proposed a vote of thanks to the President, coupled with the request that he would allow his address to be printed in the *Transactions*.

Prof. LIVEING, F.R.S., seconded the motion, which was carried by acclamation.

The PRESIDENT having returned thanks,

Prof. TILDEN, F.R.S., the Treasurer, in giving an account of the Balance Sheet which he laid before the Society, duly audited, said :—

The receipts had been :—By admission fees and subscriptions, £4088 ; by sale of Journal and advertisements, £781 15*s.* 6*d.* ; and by dividends on invested capital, £444 13*s.* 7*d.* The expenses had been : —On account of the Journal, £3388 12*s.* 11*d.* ; on account of the Proceedings, £171 14*s.* 7*d.* ; on account of the preparation of a new Card Catalogue, £35 9*s.* 2*d.* ; on account of the Library, £286 17*s.* 3*d.* ;

House expenses, including the re-decoration of the Building, £543 5*s.* 11*d.*; the total expenditure being £4993 13*s.* 1*d.* Grants amounting to £192 had been made to Fellows from the Research Fund during the year.

Attention was directed to the fact that the net income of the Society for the year being £5,371 1*s.* 5*d.*, and the expenses £4,993 13*s.* 1*d.*, the surplus is only £377 8*s.* 4*d.* This is considerably less than the amount, £578, of the Composition and Admission Fees which ought to be regarded as Capital. In view of the steadily increasing cost of the Society's publications, the recurrence of the heavy charge for the Decennial Index, and the growth of the Library, economy will have to be practised to keep the finances of the Society in a healthy condition. The Treasurer appealed to authors of papers to assist in keeping down the cost of the composing and correcting the proofs of papers communicated to the Society. At the present time the average cost of corrections amounts to more than one-third the charges for putting manuscript into type. A little more care exercised by authors in preparing for the press would result in a substantial reduction in the cost of printing.

The TREASURER, in concluding, proposed a vote of thanks to the auditors, which was acknowledged by Mr. PAGE.

Prof. ODLING, F.R.S., proposed that the thanks of the Fellows be tendered to the Treasurer for his services during the past year; this motion was seconded by Dr. RUSSELL, F.R.S, and carried.

Prof. H. B. DIXON, F.R.S., proposed a vote of thanks to the Officers and Council.

Prof. WARINGTON, F.R.S., seconded the motion, which was unanimously adopted.

Prof. DUNSTAN, F.R.S., responded on behalf of the Council.

Prof. DEWAR, F.R.S., proposed a vote of thanks to the Editor, Sub-Editor, Abstractors, and Indexers, which was seconded by Mr. GROVES, F.R.S., and carried.

Dr. WYNNE, F.R.S., responded.

The Scrutators having presented their report to the President, he declared that the following had been duly elected :—

President: T. E. Thorpe, Ph.D., D.Sc., LL.D., For.Sec.R.S.

Vice-Presidents who have filled the office of President: Sir F. A. Abel, Bart., K.C.B., D.C.L., F.R.S.; H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; James Dewar, M.A., LL.D., FR.S.; Sir J. H. Gilbert, Ph.D., LL.D., F.R.S.; J. H. Gladstone, Ph.D., D.Sc., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.B., F.R.S.; W. H. Perkin, LL.D., Ph.D., F.R.S,; Sir H. E. Roscoe, D.C.L., LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: E. Divers, M.D., D.Sc., F.R.S.; C. E. Groves, F.R.S.; G. D. Liveing, M.A., D.Sc., F.R.S.; T. Purdie, Ph.D., F.R.S.; T. Stevenson, M.D,; John M. Thomson, LL.D., F.R.S.

Secretaries: Wyndham R. Dunstan, M.A., F.R.S.; A. Scott, M.A., D.Sc., F.R.S.

Foreign Secretary: Raphael Meldola, F.R.S.

Treasurer: William A. Tilden, D.Sc., F.R.S.

Other Members of Council: H. Brereton Baker, M.A.; F. D. Chattaway, Ph.D., D.Sc.; Frank Clowes, D.Sc.; J. Norman Collie, Ph.D., F.R.S.; A. E. Dixon, M.D.; H. J. H. Fenton, M.A., F.R.S.; W. Gowland; C. T. Heycock, M.A., F.R.S.; D. Howard; Rudolph Messel, Ph.D.; W. J. Pope; James Walker, D.Sc.

March 29th, 1900. Extra Meeting. Professor THORPE, F.R.S., President, in the Chair.

Sir HENRY E. ROSCOE, F.R.S., Vice-President, delivered the Bunsen Memorial Lecture.

Before commencing the Lecture, Sir Henry Roscoe read the following telegram, which he had just received from Bunsen's nephew and executor, Dr. PHILIPP BUNSEN, of Marburg. "On the occasion of the Memorial Lecture, the Bunsen family joins sincerely with the illustrious Society, and sends respectful thanks and compliments."

The death of Bunsen on August 16th, 1899, severs the last link connecting the chemists of our time with the great men of the earlier part of the century, Berzelius, Gay Lussac, Dumas, Liebig, and Wöhler, Mitscherlich and the two Roses, as well as with the physicists Dove, Wilhelm Weber, and Magnus, all of whom he counted amongst his personal friends. Living to the ripe age of 88 years, he was destined to witness the deaths as well as the scientific births of many distinguished colleagues and pupils; of Kirchhoff, Helmholtz, Kopp, and Hermann; of Strecker, Kolbe, Kekulé, Pebal, Lothar Meyer, and, finally, of Victor Meyer, his successor in the chair at Heidelberg.

Robert Wilhelm Bunsen was born on March 31st, 1811, at Göttingen, where his father was chief University Librarian and Professor of Modern Philology. Entering the University in 1828, he studied chemistry under Stromeyer, and graduated in 1830. He then visited Paris, Berlin, and Vienna, continuing his studies and making the acquaintance of the scientific men of those cities, returning to Göttingen, where, in 1834, he was admitted by the University as Privatdozent in Chemistry. In 1836 he succeeded Wöhler as teacher of chemistry in the Polytechnic School at Cassel, and in 1839 was appointed Professor Extraordinarius of Chemistry at Marburg, being advanced in 1842 to the post of Ordinarius. Here he remained till 1851, when he went for a short period to Breslau, and in 1852 he accepted the chair at Heidelberg, which he occupied until his retirement in 1889. In these several positions, Bunsen laboured incessantly and devotedly for 56 years in the furtherance of chemical science, with the result that his name will be handed down to posterity as one whose work has earned for him the very first rank amongst chemists of the nineteenth century.

Bunsen's first published paper recorded his discovery that freshly precipitated ferric hydroxide acted as a powerful antidote in cases of arsenical poisoning, but the first research in which he showed his power was the classical one on the cacodyl compounds, which was continued for no less than six years. His important investigations on the composition of the gases of German and English blast-furnaces were of the highest practical as well as theoretical importance, and led incidentally to the devising and perfecting of his well-known system of gas analysis. In 1857, he collected in a volume the whole of his gasometric researches, and of this—the only book he ever published—a second and greatly enlarged edition appeared in 1877.

The construction of his carbon-zinc battery marks an era in the economic production of electricity. He showed how it could be employed as a means of illumination; he determined its power of doing work, and used it to prepare electrolytically many metals hitherto unknown in a coherent form, notably magnesium, the preparation of which had baffled Davy. These researches led in turn to his inventions of the well-known "grease spot" photometer and the ice- and the vapour-calorimeters. Along with the lecturer, he carried out the photochemical researches based on the action of light on a mixture of equal volumes of hydrogen and chlorine, pronounced by Ostwald to be "the classical example for all further researches in physical chemistry."

The famous researches on spectrum analysis of Kirchhoff and Bunsen gave, not only a full explanation of Frauenhofer's lines in the solar spectrum and a knowledge of the composition of the sun and the fixed stars, but led in Bunsen's hands to the discovery of two new metals, cæsium and rubidium, and in the hands of others, of thallium, indium, gallium, and other elements.

In 1846, Bunsen spent 3½ months in Iceland, as a member of an expedition promoted by the Danish Government, of which the outcome was his well-known series of investigations of the volcanic and pseudo-volcanic phenomena of that island. He worked for some time at the separation of the metals in the residues left after the extraction of the platinum, as carried out in the Imperial Mint at St. Petersburg, and in his account of this work is to be found a description of his filter pump actuated by a fall of water.

To Bunsen and Schischkoff we owe the first exact examination both of the gaseous and solid products of the explosion of gunpowder. Perhaps his name is most widely known in connection with his burner for gas, devised to provide a flame both hotter and more steady than that of the argand burner with wire-gauze top previously in use. Not only as a source of heat, but also most ingeniously as an analytic agent, was the flame of his gas burner employed in producing the delicate and characteristic "flame reactions." Important also are his papers on the colour of water, iodometric methods, and water analysis.

The remainder of the Lecture consisted of the lecturer's personal recollections of Bunsen, and of the Heidelberg Laboratories from 1852 onwards, with a description of the character and methods of work of the Master as a teacher and a lecturer, and of the relations existing between him and his pupils.

Considerate and generous towards the opinions of others, he held firmly to his own, which at times he did not fail strongly to express; simple and straightforward, he disliked assumption and hated duplicity; single-minded and wholly devoted to his science, he abhorred vanity and despised popularity hunting.

At the time of his death, Bunsen had been for many years our senior Foreign Member, having been elected on February 1, 1842, during the first session of our Society. In 1858 he became a Foreign Fellow of the Royal Society, and in 1860 the Copley Medal was awarded to him. To Bunsen and Kirchhoff, in 1877, the first award of the Davy Medal was made in recognition of their researches and discoveries in spectrum analysis.

Another English honour conferred upon him was that of the award in 1898 of the Albert Medal of the Society of Arts, given for "distinguished merit in promoting art, manufactures, or commerce," in recognition of his numerous and most valuable applications of chemistry and physics to the arts and to manufactures.

On the motion of Professor ODLING, seconded by Dr. E. ATKINSON, a vote of thanks was passed to Sir HENRY ROSCOE for his Lecture.

April 5th, 1900. Professor J. M. THOMSON, F.R.S., Vice-President, in the Chair.

Certificates were read for the first time in favour of Messrs. James Ashton, Land Hill House, Hoscar Moss, Ormskirk, Lancs.; Richard

Henry Cyril Gompertz, 110, Elgin Crescent, Notting Hill, W., Alexander Ernest McKensie, 11, Bank Road, Workington; Hugh McNair, Bellfield, Wishaw; Herbert Procter Smith, 60, Stepney Street, Llanelly; George Edward Tomlins, 4, Radford Road, Hither Green, London, S.E.

Of the following papers, those marked * were read.

*53. "The liquefaction of a gas by 'self-cooling' (a lecture experiment)." By G. S. Newth.

The principle of the modern method for obtaining liquid air or oxygen by the "regenerative" method may be illustrated for lecture purposes by means of nitrous oxide, the spiral of fine copper tube, being attached directly to the steel bottle containing nitrous oxide, and inserted into a Dewar vacuum-jacketed test-tube. No other insulating arrangements are required. In order to maintain the necessary pressure in the nitrous oxide bottle, the latter is kept in warm water at a temperature of about 30°.

*54. "Note on partially miscible aqueous inorganic solutions." By G. S. Newth.

When strong aqueous ammonia (sp. gr. 0·880) is added to a saturated solution of potassium carbonate and the liquids shaken together, two distinct layers separate out, just as in the case of water and ether. At ordinary temperatures, it is found that the potassium carbonate solution dissolves about 37 per cent. of the ammonia solution, while the latter dissolves about 6 per cent. of the potassium carbonate solution by volume.

The solubility of each liquid in the other increases with rise of temperature, the curves of their solubilities intersecting at 43°, above which temperature the solutions are miscible in all proportions. A small amount of added water is also found to increase the mutual solubility; with 12·9 per cent. of added water, the separate phases cease to exist above 10°, whilst if 18·1 per cent. of water be added, the liquids are miscible in all proportions at all temperatures above 0°. When cooled below these critical temperatures, the clear solution instantly becomes turbid by the separation into two liquids. No other aqueous solutions of inorganic substances have as yet been found which exhibit a similar behaviour, but strong aqueous solutions of trimethylamine and triethylamine behave in a like manner with a saturated solution of potassium carbonate.

Discussion.

Dr. **Divers** said that Mr. Newth's paper was interesting on account of the evidence it afforded that we had in aqueous ammonia an analogue of aqueous alcohol, the liquefied ammonia precipitating salts from aqueous solution and becoming dehydrated by potassium carbonate. He had himself shown that ammonium nitrate deliquesced in ammonia gas just as other salts deliquesced in aqueous vapour, and then furnished liquid ammonia under atmospheric pressure, which behaved as a solvent like water or alcohol.

*55. "The decomposition of chlorates. Part II. Lead chlorate."

By William H. Sodeau, B.Sc.

The preparation of pure anhydrous lead chlorate and the examination of the products of its slow decomposition were first dealt with. The solid residue was found to absorb chlorine very readily at the temperature of the decomposition (about 200—240°), hence much of the chlorine first evolved is usually reabsorbed.

When quantities of 1 gram were decomposed at atmospheric pressure in times varying from 15 to 65 minutes, the chlorine given off varied from 45 to 60·6 per cent. of the amount originally present in the chlorate actually decomposed. The employment of a stream of nitrogen increased this proportion, the series of experiments thus carried out pointing to 87·5 per cent. of chlorine as the limiting value when reabsorption is entirely eliminated, although Spring and Prost (*Bull. Soc. Chim.*, 1889, [iii], 1, 340) obtained only 8 per cent. in the decomposition of large quantities. Only 81·4 per cent. could be obtained by reducing the pressure to 2 mm., but this is probably accounted for by the necessary increase of temperature having facilitated reabsorption; it seems remarkable that decrease of pressure should markedly impede the decomposition of the chlorate. Addition of lead chloride appears to have no effect whatever.

In violent decompositions (lasting about 1 second) at atmospheric pressure, some oxychloride was formed, and only about 39 per cent. of the chlorine was obtained. Similar decompositions at pressures varying from 6 to 20 mm. gave 58·5 per cent., but the much higher temperature must no doubt have prevented the reabsorption from being even then successfully eliminated.

The author concludes that the slow decomposition of lead chlorate consists of two independent reactions: (1) $Pb(ClO_3)_2 = PbCl_2 + 3O_2$; (2) $Pb(ClO_3)_2 = PbO_2 + Cl_2 + 2O_2$, the latter having about seven times the velocity of the former. At the same time, the reaction $PbO_2 + Cl_2 = PbCl_2 + O_2$ proceeds to a greater or less extent according to the conditions, and may result in much of the chlorine being reabsorbed. The mechanism in rapid decomposition is probably similar, except that the higher temperature decomposes much of the peroxide giving oxychloride.

*56. "The bromination of benzeneazophenol." By J. T. Hewitt and W. G. Aston.

One of the authors recently (*Trans.*, 1900, **77**, 99) described the nitration of benzeneazophenol with dilute nitric acid at 40—45°. The production of benzeneazo-*o*-nitrophenol agreed with the formulation of benzeneazophenol as a hydroxylic derivative of azobenzene, but was not compatible with the structure of quinonephenylhydrazone. Shortly after the publication of these results, a note by Professor Armstrong (*Proc.*, 1899, **15**, 243) appeared in which it was stated that bromine and benzeneazophenol yielded a product giving *p*-bromoaniline and phenol on reduction. The authors find, however, that the first product of the action of bromine on benzeneazophenol is benzeneazo-*o*-dibromophenol, if the bromination is carried out in acetic acid solution to which sodium acetate is added in order to prevent any formation of quinonephenylhydrazone hydrobromide. In fact, with the exercise of care in the matter of cooling, and the slow addition of the acetic acid solution of bromine, a nearly quantitative yield may be obtained, the substance separating immediately in a very pure condition.

Benzeneazo-*o*-dibromophenol melts at 136° (corr.); it forms a well crystallised sodium salt, but no hydrochloride or hydrate has been obtained, although it gives a sulphate with concentrated sulphuric acid.

The *acetyl* derivative melts at 143°, the *benzoyl* derivative at 120°, and the *ethyl ether* at 71°. The latter compound does not show any mobility of its bromine atoms, boiling for one hour with acetone leaving it unchanged. The substitution of other azophenols is being investigated.

*57. "A new glucoside from willow bark." By H. A. D. Jowett, D.Sc.

Having had occasion to examine a bark purchased as that of black willow, which could not be further identified than as some species of *Salix*, it was found that the glucoside contained in the bark was not salicin, but a new compound. Chemical examination has shown it to be the glucoside of *m*-oxybenzaldehyde, and the name *salinigrin* is provisionally suggested for it. It is contained in the bark to the extent of about 1 per cent., and is a white, crystalline substance melting at 195° (corr.).

It is soluble in 52·2 parts of water and in 218·2 parts of alcohol at

15°, and is lævorotatory $[\alpha]_D^{15} = -87{\cdot}3°$. From salicin, it is sharply distinguished by yielding a colourless solution with sulphuric acid salicin under similar conditions producing a blood-red colour. Its formula is $C_{13}H_{16}O_7$, and it splits up, on hydrolysis, into *d*-glucose and *m*-oxybenzaldehyde.

*58. "Alkylation by means of dry silver oxide and alkyl iodides." By George Druce Lander, D.Sc.

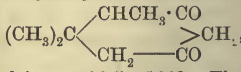
In addition to the results given (this vol., 6), the following were described. By the action of dry silver oxide and ethyl iodide on acetanilide, ethyl *i*-acetanilide, $C_6H_5N{:}C(OC_2H_5)CH_3$, is produced. This is a colourless, mobile liquid, boiling at 207—208°, easily hydrolysed by mineral acids into aniline, acetic acid, and alcohol. By warming with aniline, diphenyl ethenyl amidine, $PhN{:}C(NH{\cdot}Ph)CH_3$ (m. p. 131—132°) is formed.

Ethyl malonate, by prolonged boiling with an excess of oxide and ethyl iodide, is partially ethylated, nearly 8 grams of ethyl ethylmalonate being obtained from 32 grams of ethyl malonate.

The action of silver oxide and methyl iodide on salicylic acid gave methyl methoxybenzoate boiling at 245°; the free acid melted at 99°.

Oxidation may also occur, as in the following cases. In alkylating benzoin, part is oxidised to benzaldehyde and benzoic acid, the latter being then alkylated. In the alkylation of ethyl acetoacetate, if the iodide be added to the mixed ethereal salt and oxide, a small quantity of a high boiling oxidation product, probably ethyl diacetylfumarate, is formed which crystallises from ether in fine needles (m. p. 102—105°).

59. "The interaction of mesityl oxide and ethyl sodiomethylmalonate." By Arthur William Crossley.

By the condensation of mesityl oxide with ethyl sodiomethylmalonate, *ethyl trimethyldihydroresorcylate*, $C_{12}H_{18}O_4$, is obtained, which separates from a mixture of chloroform and light petroleum as a microcrystalline powder melting at 94°. On hydrolysis with alcoholic potash, it yields *trimethyldihydroresorcinol*,  $(CH_3)_2C\left\langle\begin{matrix}CHCH_3\cdot CO\\ CH_2\text{——}CO\end{matrix}\right\rangle CH_2$, which crystallises in clusters of needles melting at 99·5—100°. The *ethyl* ether, $C_{11}H_{18}O_2$, is a faintly yellow oil boiling at 264—265° (750 mm.), and the *silver* derivative a white, flocculent precipitate.

By oxidising the resorcinol with sodium hypobromite, it is converted into an acid having the formula $C_8H_{14}O_4$, which melts at

88° and seems to be *αββ*-trimethylglutaric acid. If the oxidation be arrested before it is complete, a *dibromo-* and a *monobromo*-derivative may be obtained. The former, having the formula $C_9H_{12}Br_2O_2$, crystallises from alcohol in needles melting at 112·5°, and the latter $C_9H_{13}BrO_2$, separates from benzene in glistening plates melting with decomposition at 152°.

The more complete investigation of the properties and reactions of the resorcinol and its derivatives is in progress.

60. "The products of the action of fused potash on dihydroxystearic acid." By Henry Rondel Le Sueur.

From the products resulting from the fusion of dihydroxystearic acid (m. p. 130·5—131°) with potassium hydroxide at a low temperature, two acids have been isolated. One of these is a dibasic acid, $C_{18}H_{34}O_5$, which crystallises from acetic acid in aggregates of long, flat needles melting at 111—111·5°. The *silver* salt, $C_{18}H_{32}O_5Ag_2$, is a white, curdy precipitate, the *calcium* salt crystallises with $3H_2O$, and the *ethyl* salt, $C_{18}H_{32}O_5Et_2$, is a slightly yellow, oily liquid boiling at 269—270° under 30 mm. pressure. The other acid, $C_{18}H_{34}O_3$, crystallises from dilute alcohol in small plates melting at 78·5—79°, and is probably identical with the acid which Saytzeff (*J. pr. Chem.*, 1886, **33**, 300) obtained in an impure state by the distillation of dihydroxystearic acid.

If the fusion of the dihydroxystearic acid be carried out at a higher temperature, the main products formed are azelaic acid, pelargonic acid, and an oil which boils at 280—300° under 50 mm. pressure.

The author intends to investigate thoroughly the various products obtained by fusing the dihydroxystearic acids (from oleic and elaidic acids) with alkalis, and to study generally the action of fused alkalis on hydroxylated fatty acids.

ADDITIONS TO THE LIBRARY.

I. Donations.

Bournon, Jacques Louis Comte de. Traité de minéralogie. Première partie, renfermant l'introduction à la minéralogie en général, la théorie de la cristallisation, l'étude de la chaux carbonatée proprement dite, et de l'arragonite, avec application du calcul cristallographique à la détermination des formes cristallines de ces deux substances. Ill. 3 vols. London 1808.

Faraday, Michael. Chemical manipulation, being instructions to students in chemistry on the methods of performing experiments of demonstration or research with accuracy and success. Ill. Third edition. London 1842.

Fourcroy, Antoine François de. Elements of chemistry and natural history, to which is prefixed the philosophy of chemistry. Fifth edition with notes by John Thomson [W. Nicholson and W. Allen]. Folding plates. 3 vols. Edinburgh 1800.

—— Chemical philosophy, or the established bases of modern chemistry. Translated from the French by W. Desmond. Third edition. London 1807.

Gren, Friedrich Albert Carl. Principles of modern chemistry, systematically arranged. Ill. 2 vols. London 1800.

Griffin, John Joseph. A system of crystallography with its application to mineralogy. Glasgow 1841.

Henry, William. An epitome of chemistry in three parts . . . . Second edition. London 1801.

Lemery, Nicholas. Cours de chemie . . . . Nouvelle édition revuë, corrigée, et augmentée par Theodore Baron. Ill. Paris 1757.

Macquer, Pierre Joseph. A dictionary of chemistry . . . . translated from the French, with plates, notes, and additions by the translator. Ill. 2 vols. in 1. London 1771.

Noad, Henry Minchin. Chemical manipulation and analysis. Part I. Manipulation and qualitative analysis. Part II. Quantitative analysis. Ill. 2 vols. London 1848.

Normandy, Alphonse Réné le Mire. Practical introduction to H. Rose's treatise on chemical analysis, illustrated by synoptic tables and numerous formulas. London 1849.

Pharmaceutical Times, The. A journal of chemistry applied to the arts, agriculture, and manufactures. Vols. I—III. Sept. 5, 1846. Nov. 4, 1848. *continued as*

Chemical Times, The, and Journal of Pharmacy, manufactures, agriculture, and the industrial arts [edited by G. M. Mowbray]. Vol. IV. Nov. 11, 1848—May 5, 1849. London.

Thomson, R. D. A cyclopædia of chemistry, practical and theoretical, with its applications to mineralogy, physiology, and the arts. Ill. London 1854.

Thomson, Thomas. A system of chemistry. Ill. Second edition. 4 vols. Edinburgh 1804.

—— The same. Third edition. 5 vols. Edinburgh 1807.

From the Institute of Chemistry.

A familiar grammar of the principles and practice of chemistry for the use of schools, illustrated by experiments. London 1810.

Bergman, Sir Torbern. An essay on the usefulness of chemistry, and its application to the various occasions of life. London 1783.

Nicholson, William. The first principles of chemistry. Second edition. London 1792.

Rose, Hermann. Chemical tables for the calculation of quantitative analysis. . . . recalculated . . . by William P. Dexter. Boston 1850.

—— A practical treatise of chemical analysis, including tables for calculations in analysis. Translated by A. R. le M. Normandy. London 1848.

Skrimshire, Fenwick. A series of popular chymical essays: containing a variety of instances of the application of chymistry to the arts and manufactures, to the explanation of natural phenomena, and other useful purposes. Vol. I. only. London 1802.

From J. H. Williamson, Esq., through H. E. Brothers, Esq.

Helm, Georg. The principles of mathematical chemistry: the energetics of chemical phenomena. Translated by J. Livingston R. Morgan. New York 1897. From the Translator.

Ladenburg, A. Lectures on the history and development of chemistry since the time of Lavoisier. Translated from the second German edition by Leonard Dobbin. Edinburgh 1900.

From the Author.

Morgan, J. Livingston R. The elements of physical chemistry. New York 1899. From the Author.

—— An outline of the theory of solution and its results: for chemists and electricians. New York 1897. From the Author.

Richter, Victor von. Organic chemistry, or chemistry of the carbon compounds. Edited by R. Anschütz and G. Schroeter. Translated by Edgar F. Smith. 3rd American from 8th German edition. Vol. II. Carbocyclic and heterocyclic series. London 1900.

From the Publishers.

Warington, R. Lectures on some of the physical properties of soil. With frontispiece. Oxford 1900. From the Author.

—— Sulphate of ammonia, its characteristic and practical value as a manure. London 1900. From the Author.

Pamphlet.

Spring, W. La plasticité des corps solides et ses rapports avec la formation des Roches. Bruxelles 1899. From the Author.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 3rd, 1900.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

Bain, Alexander William,

2, Muswell Rise, Highgate, N.

Tutor and Teacher of Chemistry. Student at Northern Polytechnic Instn., B.A. (Lond. Univ.), Inter. B.Sc. (Lond.). Advanced Stage Cert. Sci. and Art Dept. Pract. and Theor. Inorg. Chem. Desirous of increasing my knowledge of Chemistry.

Jn. H. Allworthy. H. F. C. Goltz.
J. T. Dunn. *John Spiller.*
H. T. Sorrell. *Geo. Chaloner.*
F. Southerden. *Arthur J. Starey.*

Beringer, Heinrich Rowland,

11, Dolcoath Road, Camborne.

Druggist and Assistant in Chemistry at the Camborne Mining School. In 1882—1883, two years' training in General and Analytical Chemistry in the Laboratory of the Public Analyst for Cornwall. During the last eight years has made steady progress in Mineral Chemistry.

J. Paul de Castro. John J. Beringer.
John Gill. *William A. Tilden.*
John C. Umney.

Britten, Frank Curzon, B.A.,

21, Osbaldeston Road, London, N.

Second Master in Peter Symond's School, Winchester (School of Science). Science Master, Thame Grammar School, September, 1895 to December, 1898. First Assistant, Mansfield Technical School, January—July, 1899. Tutor in St. Mark's College, Chelsea, September—December, 1899.

W. W. Fisher. A. E. Tutton.
A. Vernon Harcourt. J. E. Marsh.
P. Elford. C. H. H. Walker.

Brooke, John Richard, A.I.C.,

20, Aberdeen Park, Highbury, N.; also 37, Mincing Lane, E.C.

Analytical Chemist. Over nine years' practical experience in Analytical Chemistry under Professor John Attfield, F.R.S., and Professor Wyndham R. Dunstan, F.R.S., Sec.C.S. Latterly Analyst to the Lonsdale Hæmatite Smelting Co., Ltd., Whitehaven. Now in business on my own account. Have passed the Final Examination (January, 1900) of the Institute of Chemistry for the Associateship.

Wyndham R. Dunstan.
Julian L. Baker.
Bernard Dyer.
Arthur W. Crossley.
H. R. Le Sueur.
Samuel Hall.

Chater, Arthur Brand,

65, Queen Street, Brisbane.

Analytical Chemist. Formerly Lecturer in Chemistry at the College of Pharmacy, Brisbane. Member and ex-President of Queensland Pharmacy Board. Examiner to the Board in Chemistry. Have been retained by the Queensland Government as Consulting Chemist in Industrial Matters.

Wm. Martindale.
John Barclay.
Peter MacEwan.
Ernest J. Parry.
Fred W. Fletcher.
J. West Knights.

Cullinan, Nicholas,

Risca, Monmouthshire.

M.D. (Brux.), L.R.C.P., L.R.C.S., L.F.P.S.G., L.M., D.P.H. (Dublin). Six months' Theoretical work, six months' Practical work, and six months' Analytical work for D.P.H.

Geo. R. Thompson.
Clarence A. Seyler.
Stevenson Macadam.
G. H. Gemmell.
W. Ivison Macadam.
Stevenson Macadam, jun.

Cussons, John, B.Sc., A.C.P.,

4, Mount Pleasant, Portmadoc.

Science Master at the County Intermediate School, Portmadoc, Carnarvon. Bachelor of Science (Victoria). Student of Chemistry for four years at the Yorkshire College, Leeds. Since Science Master at the County Intermediate School, Portmadoc.

Arthur Smithells.
J. B. Cohen.
Herbert Ingle.
Thos. Ewan.
Richd. Spencer.

Davis, Arthur Charles,

3, Vinery Road, Cambridge.

Chemist in Chemical Manufactory. Chief Chemist to Messrs.

Keeble Bros., Ltd., and the Saxon Portland Cement Co., Ltd., Cambridge. Late Chemist (now Director) Evison's Chemical Works, Ramsey, Hts. Late Assistant in the Cambridge County Laboratory. Interested in the Chemistry of Cements, Clays, and Agriculture. Contributor of articles on Portland Cement Manufacture to *The British Clayworker*. Desirous of obtaining the Society's publications as an aid to study.

J. West Knights. Austin Keen.
Arthur Deck. William Elborne.
D. B. Butler.

Deerr, Noël Fielding,
26, South Parade, Chelsea, S.W.

Analytical Chemist. Associate of the City and Guilds of London Institute. Resident Chemist at Plantation Albion, Demerara. Author of three papers dealing with the thermal constants of the Elements. *Proc. Chem. Soc.*, June 6th, 1895, *Chemical News* (71, p. 303 ; 76, p. 224).

Henry E. Armstrong. F. Stanley Kipping.
Gerald T. Moody. G. Harris Morris.
Arthur R. Ling.

Donald, William,
Saltcoats, Ayrshire.

Explosives Chemist. I received my general education at Glasgow from 1862—1873. I studied Chemistry at Glasgow under Dr. Moffat, Dr. Thorpe, and Mr. M. M. Pattison Muir. I was for five years Assistant Chemist to Mr. James Mactear, St. Rollox, Glasgow. Chemist to Nobels, Glasgow, for ten years. Laid out works in Cornwall. Chief Chemist and Works Manager to Explosives Company in South Wales. Inventor of the Chlorine Processes which bear my name. Chemical Engineer to War Office, Turkey. Now Chief Chemist and Works Manager to High Explosives Company, Great Oakley, Essex.

James Mactear. R. T. Thomson.
R. R. Tatlock. *Frank W. Young.*
John S. Lumsden.

Eadie, Robert, jun.,
31, Clarendon Street, Partick, N.B.

Analytical Chemist. Studied Chemistry for three Evening Sessions under Professor A. H. Sexton, F.C.S., F.I.C., at the Glasgow and West of Scotland Technical College; and for ten years Assistant with Dr. C. M. Aikman, F.C.S., F.I.C., in his private laboratory.

C. M. Aikman. R. T. Thomson.
R. R. Tatlock. James Robson.
A. Humboldt Sexton.

Ellis, Frederic Richard,

15, Elton Road, Bishopston, Bristol,

Chemist. Minor Diploma Pharmaceutical Society, Great Britain, 1894. Assistant Diploma Society Apothecaries, London, 1891. Engaged in Manufacturing Chemistry and Analytical Work for Major Diploma of the Pharmaceutical Society, and B.Sc. Degree London University.

Ernest H. Cook.
Frank H. Alcock.
H. W. Jones.
Sydney Young.
W. F. Wyley.

FitzGibbon, Thomas,

1, Clyde Cottages, Ilford, Essex.

Analytical and Manufacturer's Chemist. Late Assistant Chemist at "The London School of Brewing and Chemistry," now Analytical and Manufacturing Chemist to "The Victoria and Royal Albert Docks' Chemical Works.

Theo. D. Lichtenstein.
F. Jewson.
D. S. Macnair.
J. T. Hewitt.
L. W. Mathieson.
Edgar S. Barralet.
F. Southerden.

Fowler, Morris Broad,

30, West Park, Clifton, Bristol.

Chemist and Works Manager. Have studid Chemistry under Prof. R. Meldola, F.R.S., and also under Profs. W. Jago, F.I.C., and A. G. Bloxam. Have taken First Class Intermediate Scientific Lond. Univ. Have patented various improvements in technical processes.

William Jago.
A. G. Bloxam.
R. Meldola.
F. Southerden.
Gerald T. Moody.
W. A. Lethbridge.
W. A. Davis.
E. C. Jee.

Halstead, Reginald Gordon,

3, Rathbone Place, Oxford Street, London.

Chemist in the Laboratories of Messrs. Burgoyne, Burbidges and Co., London. Have been a Student of Chemistry for some years and had considerable experience in Analytical Work.

Thos. Farries.
Theophilus Pitt.
Thos. Tyrer.
H. Wilson Hake.
John Moss.

Haynes, James Herbert,

73, Boynland Avenue, Bishopston, Bristol.

Science Teacher. B.Sc. (Victoria). Studied Chemistry three years at The Owens College, Manchester. Science Teacher, Urmston

Higher Grade School, 1896—1898. Science Master at the Fairfield Higher Grade School, Bristol. Evening Lecturer in Chemistry.

H. B. Dixon. W. H. Perkin, jun.
Wm. A. Bone. G. H. Bailey.
J. F. Thorpe.

Jennings, Henry,

Marlowes, Hemel Hempstead, Herts.

Analyst to London County Council. Student under Prof. Coleman at South Western Polytechnic, Chelsea, from Sept. 1896 to July 1899. Obtained the Associateship of the Institute in Chemistry in 1899. At present time Asst. Chemist, Northern Sewage Outfall, Beckton, Chemical Dept. of the London County Council.

J. Bernard Coleman. *C. J. S. Makin.*
Frank Clowes. *H. F. Fermor.*
R. Grimwood. *E. T. Shelbourn.*

Kershaw, James Henry,

21, Richmond Park Rd., Kingston-on-Thames.

Analytical Chemist. For several years I was a Student under Mr. R. W. Oddy, F.I.C., F.C.S., and Mr. Wm. Marshall, F.I.C., F.C.S., Rochdale. For 6 years I was Assistant to Mr. Oddy, F.I.C., F.C.S., Analytical and Consulting Chemist, Rochdale. At present I am Chemist at Sewage Works, Kingston-on-Thames.

Robt. W. Oddy. T. Mitchell.
William Marshall. *William Dixon.*
Thos. Stenhouse *Walter M. Gardner.*

Liebmann, Adolf,

10, Marsden Street, Manchester.

Ph.D. and M.A. of University of Bonn. For 3 years Assistant of Kekulé. Among papers published: "Synthesis of Cumene"; "Synthesis of the Homologues of Phenol," &c.

James Dewar. W. H. Perkin, jun.
Henry E. Roscoe Alexander Scott.
Henry E. Armstrong.

Lockhart, Thomas Lamb,

Johannesburg, Transvaal.

Analytical Chemist and Assayer. 1889—1893, Assistant Chemist and Assayer, Pollok Gold Extracting Process, Glasgow—California; 1893—1898, Chief Chemist and Assayer, Langlaagte Estate and Gold Mining Co., Ltd., Johannesburg; 1898 to present time, Cyanide Manager and Chemist, Glencairn Main Reef G. M. Co., Ltd., Johannesburg.

Stevenson Macadam. Stevenson Macadam, jun.
W. Ivison Macadam. G. H. Gemmell.
W. S. Anderson.

Macara, Thomas,

6, West Bank Terrace, Hillhead, Glasgow.

City Analyst's Assistant. Student for 3 years with Dr. John Clark, City Analyst, Glasgow. Attended Dr. Clark's Lectures on Chemistry, and Lectures at the Technical College, Glasgow, on Chemistry, Mathematics, Magnetism, and Electricity. Assistant with Dr. Clark for the past 8½ years.

John Clark.
R. R. Tatlock.
R. T. Thomson.
Thomas Gray.
Matthew A. Parker
G. G. Henderson

Munton, Frederick Thomas,

The Oak House, Winsford, Cheshire.

Analyst to Salt Union. Associate of the Royal School of Mines.

W. C. Roberts-Austen.
William A. Tilden.
W. Palmer Wynne.
W. Gowland.
A. Stansfield.

Pettigrew, Robert,

50, Cresswell Grove, West Didsbury, Manchester.

Analytical Chemist. 3 years Student in Chemistry under the late Professor Dittmar, F.R.S., at the Andersonian College, Glasgow. 2 years Chemist to the London Metallurgical Company. 5 years Assistant Chemist in the laboratory of Sir Henry Roscoe, F.R.S. Silver Medallist of the City and Guilds Institute.

Henry E. Roscoe.
Frank Scudder.
Harry Grimshaw.
Gilbert J. Fowler.
J. Carter Bell.

Phillpotts, Geoffrey Surtees,

82, James Street, Dublin.

Brewing at Guinness's, Dublin. Studied Chemistry for 4 years at Cambridge, taking 1st and 2nd Classes in Parts I. and II. respectively Nat. Sci. Triposes, June, 1898 and 1899. Taught Chemistry at Bedford Grammar School, September to December 1899.

S. Ruhemann.
H. J. H. Fenton.
C. T. Heycock.
F. H. Neville.
T. B. Case.

Sandford, James Wallace,

Adelaide, South Australia, *pro. tem.* c/o Mr. F. J. Lloyd, 4,
Lombard Court, London, E.C.

Interested in Chemistry as applied to Agriculture in Australia. Studied Chemistry at St. Peter's College, Adelaide, S. Australia, for 4 years. Also at the Government Agricultural College of South Australia, 18 months. Have been pupil for Chemistry under Mr. F. J.

Lloyd, F.I.C., for 18 months at above address. Have certificates for passing the Junior and Senior Public Examinations, Adelaide University, South Australia.

Fredk. J. Lloyd. Jas. McCreath.
Alexander Cameron. *J. H. M. Fallon.*
J. Henry Gilbert.

Steele, Bertram D., B.Sc. (Victoria),
40, Herndale Road, London, S.W.

1851 Exhibition Research Scholar in the School of Chemistry. Joint Author with Professor Masson of paper "The Blue Salt of Fehling's Solution." Lately *locum tenens* for Professor Rennie at the University of Adelaide.

J. Norman Collie. William Ramsay.
Arthur Lapworth. Edward Bevan.
Thomas Tickle. C. F. Cross.

Tilley, James Walter,
2, Stockwell Crescent, London, S.W.

Consulting and Research Chemist to Messrs. Stevenson and Howell, Ltd, Manufacturing Chemists, Southwark Street, S.E. Have been engaged for 15 years as Laboratory Chemist in connection with Pharmacy and Aërated Water Manufacture. Studied Chemistry and Physics three years at the Birkbeck Institute. Have conducted various researches on Essential Oils with the object of perfecting manufacturing processes.

Reginald Howell. J. E. Stead.
William Stevenson. *H. Helbing.*
Charles A. Wrench. *Peter MacEwan.*

Walker, Augustus John,
3, Arnold Street, Hull.

Science Master. Degree of Bachelor of Science (Vict.). Associate of the Yorkshire College. Five years Lecturer in Theoretical and Practical Chemistry in Day and Evening Science Schools.

Jas. Baynes. *H. Irving Foster.*
Harry Thompson. *G. Carr Robinson.*
Frederick William De Velling. *Alf. J. Parker.*

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

Issued 9/5/1900

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 223.

May 3rd, 1900. Professor THORPE, F.R.S., President, in the Chair.

A ballot for the Election of Fellows was held, and the following were subsequently declared duly elected :—Messrs. Alexander William Bain, B.A., Heinrich Rowland Beringer, Frank Curzon Britten, B.A., John Richard Brooke, A.I.C., Arthur Brand Chater, Nicholas Cullinan, M.D., John Cussons, B.Sc., Arthur Charles Davis, Noël Fielding Deerr, William Donald, Robert Eadie, Frederic Richard Ellis, Thomas FitzGibbon, Morris Broad Fowler, Reginald Gordon Halstead, James Herbert Haynes, B.Sc., Henry Jennings, James Henry Kershaw, Adolf Liebmann, M.A., PhD., Thomas Lamb Lockhart, Thomas Macara, Frederick Thomas Munton, Robert Pettigrew, Geoffrey Surtees Phillpotts, B.A., James Wallace Sandford, Bertram D. Steele, B.Sc., James Walter Tilley, Augustus John Walker, B.Sc.

Certificates were read for the first time in favour of Messrs. George Edward Battle, Totlands, Dane Park, Ramsgate; John Henry Gough, 22 Francis Street, Chapeltown Road, Leeds; Percy John Hinks, 16 Moreton Road, South Croydon; Tajiro Ichioka, 8 Nottingham Place, London; David Herbert Patrick, Earlsdon, Coventry; Timothy A. Smiddy, Kilbarry House, Cork, Ireland.

Of the following papers, those marked * were read :—

***61. "The substituted nitrogen chlorides and nitrogen bromides derived from ortho- and para-acet-toluide." By F. D. Chattaway and K. J. P. Orton.**

Both *o*- and *p*-acet-toluide when treated with hypochlorous or hypobromous acid, produce nitrogen chlorides and bromides which readily undergo transformation into the isomeric substituted toluides; these in their turn form nitrogen chlorides and bromides, which pass into the disubstituted toluides, in which the amino-hydrogen is again replaceable by chlorine or bromine. As with the substituted anilides, when the ortho- and para-positions relatively to the acetamino-group are occupied, the compounds undergo no further isomeric change, hydrolysis or decomposition resulting from attempts to induce it.

The halogen, exactly as in the case of acetanilide or a substituted acetanilide, is found always to take up the para-position when this is possible, and when this position is occupied, the ortho-position, relatively to the carbon to which the nitrogen is attached. The authors have shown (*Trans.*, 1899, **75**, 1046; 1900, **77**, 134; *Ber.*, 1899, **32**, 3573) that substitution by chlorine or bromine in anilines and anilides is not a direct process, but a result of the transformation of a nitrogen chloride or bromide, a hypochlorite or hypobromite being probably formed first by the nitrogen becoming quinquevalent. The behaviour of the nitrogen chlorides and bromides derived from the toluides is in entire agreement with this conclusion.

The properties of the nitrogen chlorides and bromides obtained from the toluides resemble exactly those of other members of the class. The nitrogen chlorides are colourless, the nitrogen bromides sulphur-yellow solids, all crystallising well in four-sided prisms terminated by domes.

All show the general reactions of nitrogen chlorides and bromides. They react with alcohol, re-forming the toluide and producing ethyl hypochlorite or hypobromite, although this action is usually accompanied by a considerable amount of isomeric change.

They react with ammonia liberating nitrogen, with hydrocyanic acid forming cyanogen chloride or bromide, with hydrogen chloride, bromide or iodide setting free the halogen, and with hydrogen peroxide oxygen, in each case the toluide being re-formed. On warming with dilute acids, a certain amount of hydrolysis accompanies the isomeric change, and this, in the case of the nitrogen bromides, is the chief action.

The following compounds are described:

o-*Methyl-phenyl-acetyl-nitrogen chloride* (ortho-acet-chloramino-toluene), $CH_3\cdot C_6H_4\cdot NCl\cdot COCH_3$, m. p. 43°.

Methyl-chlor-phenyl-acetyl-nitrogen chloride (ortho-acet-chloramino-5-chlor-toluene), $CH_3 \cdot Cl \cdot C_6H_3 \cdot NCl \cdot COCH_3$ (Me : Cl : : 2 : 4), m. p. 66°.

Methyl-dichlor-phenyl-acetyl-nitrogen chloride (ortho-acet-chloramino-3-5 dichlortoluene), $CH_3 \cdot Cl_2 \cdot C_6H_2 \cdot NCl \cdot COCH_3$ (Me : Cl : Cl : : 2 : 4 : 6), m. p. 78°.

p-*Methyl-phenyl-acetyl-nitrogen chloride* (para-acet-chloramino-toluene), $CH_3 \cdot C_6H_4 \cdot NCl \cdot COCH_3$, m. p. 91—92°.

Methyl-chlor-phenyl acetyl nitrogen chloride (para-acet-chloramino-3-chlor-toluene), $CH_3 \cdot Cl \cdot C_6H_3 \cdot NCl \cdot COCH_3$ (Me : Cl : : 4 : 2), m. p. 48°.

Methyl-dichlor-phenyl-acetyl nitrogen chloride (para-acet-chloramino-3:5-dichlor-toluene), $Cl_2 \cdot CH_3 \cdot C_6H_2 \cdot NCl \cdot COCH_3$ (Me : Cl : Cl : : 4 : 2 : 6), m. p. 72°.

o-*Methyl-phenyl-acetyl nitrogen bromide* (ortho-acet-bromamino-toluene), $CH_3 \cdot C_6H_4 \cdot NBr \cdot COCH_3$, m. p. 100·5°.

Methyl-brom-phenyl-acetyl-nitrogen bromide (ortho-acet-bromamino-5-brom-toluene), $CH_3 \cdot Br \cdot C_6H_3 \cdot NBr \cdot COCH_3$ (Me : Br : : 2 : 4), m. p. 91°.

Methyl-dibrom-phenyl-acetyl-nitrogen bromide (ortho-acet-bromamino-3 : 5-dibromotoluene), $CH_3 \cdot Br_2 \cdot C_6H_2 \cdot NBr \cdot COCH_3$ (Me : Br : Br : : 2 : 4 : 6), m. p. 120.

p-*Methyl-phenyl-acetyl-nitrogen bromide* (para-acet-bromamino-toluene), $CH_3 \cdot C_6H_4 \cdot NBr \cdot COCH_3$, m. p. 94—95°.

Methyl-brom-phenyl-acetyl-nitrogen bromide (para-acet-bromamino-3-brom-toluene), $Br \cdot CH_3 \cdot C_6H_3 \cdot NBr \cdot COCH_3$ (Me : Br : : 4 : 2), m. p. 87°.

Methyl-dibrom-phenyl-acetyl-nitrogen bromide (para-acet-bromamino-3 : 5-dibromo-toluene), $Br_2 \cdot CH_3 \cdot C_6H_2 \cdot NBr \cdot COCH_3$ (Me : Br : Br : : 4 : 2 : 6), m. p. 118°.

*62. "The estimation of hypoiodites and iodates; and the reaction of iodine monochloride with alkalis." By K. J. P. Orton and W. L. Blackman.

The method of estimating hypoiodites is based on the oxidation of sodium arsenite by hypoiodites, but not by iodates. Excess of the standard arsenite is used, and the unoxidised portion titrated with iodine after the saturation of the alkali by carbon dioxide. The iodate can then be determined by acidifying and titrating the iodine liberated. The hypoiodite solutions were prepared chiefly from iodine monochloride (dissolved in hydrochloric acid), and also from iodine solution. The initial reaction of iodine monochloride and alkalis is represented by the equation $ICl + 2MOH = MIO + MCl + H_2O$.

With potash, soda, lime water, and baryta water, the whole of the iodine is for a short time (varying from 30 seconds to 5 minutes) present as hypoiodite. The transformation into iodate and iodide is practically complete after 24 hours. With ammonia, the complete transformation requires 2 or 3 weeks. The solution obtained from methylamine and iodine monochloride behaves in an exceptional manner, the hypoiodite gradually disappearing, probably oxidising the methylamine. The bleaching of indigo is shown to be unsuitable for the purpose of estimating hypoiodites, owing to the direct action of even dilute alkalis on the indigo.

The solutions obtained by shaking up iodine with mercuric oxide and water contain chiefly iodate, and only a small quantity of hypoiodite.

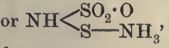
DISCUSSION.

In reply to the President, Dr. ORTON said that the work of which he had given an account was completed fifteen months before the abstract of R. L. Taylor's paper (*Proc.*, 1900, **16**, 70) appeared.

*63. "Products of the action of sulphur dioxide on ammonia." By Edward Divers.

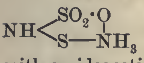
When the paper on "Ammonium amidosulphite" (Divers and Ogawa, *Proc.*, 1900, **16**, 38; *Trans.*, 1900, **77**, 327) was communicated to the Society, the authors were unaware that a paper on the subject of this note had been published by Schumann (*Zeit. anorg. Chem.*, 1900, **23**, 43). Beyond the fact that Schumann also points out the incorrectness of Rose's statement that sulphur dioxide combines with only its own volume of ammonia, the two papers have nothing in common. The main fact established in the paper by Ogawa and the author was the existence of ammonium amidosulphite, of which they had already given notice in a paper on "Ethyl ammoniumsulphite" (*Trans.*, 1899, **75**, 534). Schumann has obtained a product of the same composition as ammonium amidosulphite in red masses, not very hygroscopic, it dissolves in water to a yellow solution, forming ammonium sulphate, sulphite, thiosulphate, trithionate, and pentathionate, whilst ammonium amidosulphite is a white, crystalline powder, extremely deliquescent, and soluble in water, forming ammonium sulphite only. Schumann obtained two other products, having respectively the formulæ SO_2,NH_3 and $3SO_2,4NH_3$, the aqueous solutions of which were similar to that given by the red substance $SO_2,2NH_3$. The author can only regard Schumann's three products as mixtures of substances formed by the spontaneous decomposition of ammonium amidosulphite.

Since the publication of the paper on ammonium amidosulphite, further work by Ogawa has fully established the existence amongst the products of the decomposition of this salt of the compound formulated (*loc. cit.*, p. 334) as $(NH_3)_2S_2O_3$, but of which the true formula is

$N_2H_4S_2O_3$. Although only faintly acid to litmus, it forms salts, of which the *ammonium salt*, $NH_4N_2H_3S_2O_3$, the *potassium salt*, $KN_2H_3S_2O_3$, the *barium salt*, $Ba(N_2H_3S_2O_3)_2,2H_2O$, and the *lead salt*, $Pb(N_2H_3S_2O_3)_2$, have been prepared. The constitutional formula $NH_2\cdot S\cdot NH\cdot SO_3H$, or  $NH<\begin{matrix}SO_2\cdot O\\ S—NH_3\end{matrix}$, seems to express the relations of this substance as far as they are at present known.

This preliminary notice is published because, unfortunately, the circumstances in which the author and Ogawa are placed afford little hope of the full account of the products of the decomposition of ammonium amidosulphite being ready for publication for some considerable time to come.

Discussion.

Dr. Travers asked if the author attributed the formula  $NH<\begin{matrix}SO_2\cdot O\\ S—NH_3\end{matrix}$ to the compound he had described merely from analogy with amidoacetic acid.

Dr. Hewitt asked whether any decomposition products of the compound $N_2H_4S_2O_3$ had been obtained in which the sulphur and nitrogen were still linked together. There seemed to be a possibility of isolating the sulphur analogue of hydroxylamine, or some compound nearly related to it.

Dr. Divers replied that this substance hydrolysed as a sulphonic acid, and yet was not acid to litmus like all other sulphonic acids. The red substance soluble in carbon disulphide and ether might well be the sulphur amide, $S(NH_2)_2$, supposed to exist by Forchhammer.

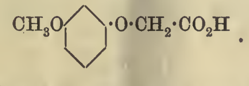
64. "On Brazilin. IV." By A. W. Gilbody, W. H. Perkin, jun., and J. Yates.

In a previous communication (*Proc.*, 1899, **15**, 27), it was shown that trimethylbrazilin, $OH\cdot C_{16}H_{10}O(OCH_3)_3$, when oxidised with chromic acid, is converted into *trimethylbrazilone*, $OH\cdot C_{16}H_8O_2(OCH_3)_3$, and that this substance, when heated, loses water, with formation of *dehydrotrimethylbrazilone*, $OH\cdot C_{16}H_6O(OCH_3)_3$, a compound which yields an acetyl derivative, and which is evidently identical with the acetyl compound which Herzig prepared by the oxidation of acetyltrimethylbrazilin (*Monatshefte*, 1895, **16**, 913). The authors now find that trimethylbrazilone, on treatment with phenylhydrazine, is reduced to a substance having the formula $C_{19}H_{18}O_4$, which melts at 173°, and dissolves in nitric acid and other concentrated mineral acids, yielding intense purple or orange solutions.

When trimethylbrazilin is oxidised with potassium permanganate under various conditions, a variety of substances are formed, the principal of which are the following:

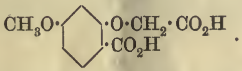
(1.) A dibasic acid, $C_{10}H_{10}O_6$, melting at 175°. This acid contains one methoxyl group, and is derived from the resorcinol portion of the molecule of brazilin, because, when fused with potash, it yields a substance which gives an intense violet coloration with ferric chloride.

When heated with water at 200°, this acid, $C_{10}H_{10}O_6$, is decomposed, with elimination of carbonic anhydride and formation of a monobasic acid, $C_9H_{10}O_4$ (m. p. 119°), which has been shown by synthesis to have the constitution

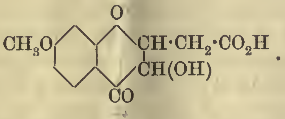


In synthesising this acid, for which the name *methylresorcinolacetic acid* is proposed, pure methylresorcinol, $CH_3O{\cdot}C_6H_4{\cdot}OH$, was treated with sodium ethoxide and ethyl bromacetate, and in this way *ethyl methylresorcinolacetate*, $CH_3O{\cdot}C_6H_4{\cdot}O{\cdot}CH_2{\cdot}CO_2Et$, was obtained as a thick, colourless oil boiling at 182° (25 mm.); this, on hydrolysis, yielded the corresponding acid which melted at 119°, and was found to be identical with the acid $C_9H_{10}O_4$, obtained from brazilin as described above.

Since brazilin under other conditions (see below, and *Proc.*, 1899, 15, 27—29) yields *p*-methoxy-salicylic acid, it follows that the acid, $C_{10}H_{10}O_6$, must be the *methylcarboxyresorcylacetic acid* having the formula



(2.) A monobasic acid, $C_{10}H_8O_3(OCH_3){\cdot}CO_2H$, melting at 129·5°, which has already been described (*Proc.*, 1899, 15, 29). We find that this acid, when treated with concentrated sulphuric acid at 80°, loses water, and is converted into an acid, $C_{12}H_{10}O_5$, which melts at 196°, and when oxidised with permanganate yields *p*-methoxy-salicylic acid. It is therefore probable that the acid, $C_{10}H_8O_3(OCH_3){\cdot}CO_2H$, has the constitution



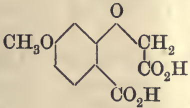
(3.) An acid very sparingly soluble in water and melting at 208°. This acid has the formula $C_{19}H_{18}O_9$; it yields a *silver* salt, $C_{17}H_{16}O_5(CO_2Ag)_2$, and a *dimethyl* salt, $C_{17}H_{16}O_5(CO_2Me)_2$ (m. p. 110°), and is therefore dibasic. When fused with potash, it yields a substance soluble in water, which, with ferric chloride, gives an intense catechol reaction; it does not form an oxime, but when reduced with sodium amalgam, it is converted into an acid, $C_{17}H_{16}O_4(CO_2H)_2$, which melts at 227°.

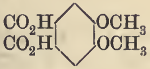
When the acid $C_{17}H_{16}O_5(CO_2H)_2$ is heated at 140° with alcoholic potash, it is decomposed with formation of a neutral substance, the analysis of which agrees better with the formula $C_{17}H_{20}O_5$ than with $C_{17}H_{18}O_5$; it appears probable therefore that, besides elimination of carbonic anhydride, reduction has taken place according to the equation $C_{17}H_{16}O_5(CO_2H)_2 + 2H = C_{17}H_{20}O_5 + 2CO_2$. This substance crystallises from alcohol in needles, melts at 140°, and appears to be a lactone.

(4.) An acid very sparingly soluble in water, which melts at 214—215° with vigorous decomposition, and gives also an intense catechol reaction after fusion with potash and treatment with ferric chloride. The results of one analysis point to this acid having the formula $C_{13}H_{14}O_8$, but, unfortunately, it has so far been obtained in such small quantity that the analysis could not be repeated.

(5.) Metahemipinic acid.

Constitution of Brazilin.—The results described in this and previous communications, and especially the isolation of methylcarboxyresorcylacetic acid and of metahemipinic acid,





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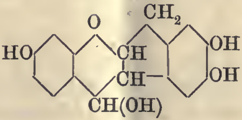
from among the products of the oxidation of brazilin, allow of only a very few formulæ as possible expressions of the constitution of this substance, and after carefully considering all the facts, the authors are of the opinion that brazilin probably has the constitution represented by the formula,



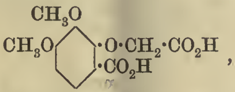
65. "On Hæmatoxylin. V." By W. H. Perkin, jun., and J. Yates.

When *tetramethylhæmatoxylin*, $OH{\cdot}C_{16}H_9O(OCH_3)_4$, is oxidised by potassium permanganate under various conditions, it yields the following substances:

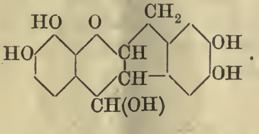
(1.) *Metahemipinic acid*, which was characterised by analysis and by conversion into the characteristic ethylimide melting at 230°. The formation of this acid from tetramethyl-hæmatoxylin by oxidation with chromic acid has already been mentioned (*Proc.*, 1899, 15, 241).

(2.) An acid melting at 180°, which evidently corresponds with the acid $C_{17}H_{16}O_5(CO_2H)_2$ (m. p. 208) obtained from trimethylbrazilin as described in the preceding abstract. This acid has the formula $C_{18}H_{18}O_6(CO_2H)_2$, and is dibasic, since it yields a silver salt $C_{18}H_{18}O_6(CO_2Ag)_2$. It dissolves in concentrated sulphuric acid with a crimson colour, and when reduced with sodium amalgam is converted into an acid, $C_{18}H_{18}O_5(CO_2H)_2$, which melts at 194°.

(3.) An acid melting at 214°, which, when fused with potash, is converted into a substance which with ferric chloride gives the pyrogallol reaction. This acid has the formula $C_{11}H_{12}O_7$, and is dibasic, since its silver salt has the composition $C_{11}H_{10}Ag_2O_7$. It contains two methoxyl groups, and when heated with concentrated hydrochloric acid at 200° it yields pyrogallol. When treated with acetic anhydride, it gives an anhydride, $C_{11}H_{10}O_6$ (m. p. 154°); it therefore has the constitution:



and corresponds with the methylcarboxyresorcylic acid obtained from brazilin. The formation of this acid and of metahemipinic acid from hæmatoxylin leads us to believe that the constitution of this substance is represented by the formula



66. "Note on the function of the characteristic meta-orientating groups." By Arthur Lapworth.

The author desires to draw attention to the following points, the significance of which does not appear to be generally recognised.

The groups ·CO·R, ·NO_2, ·CN, ·SO_2R are known to produce the following effects when in direct attachment to—

(1.) *A benzenoid nucleus.*—They render the hydrogen atom in the *meta*-position directly replaceable by all the characteristic substituting agents, thus differing from all other known groups.

(2.) *A* $\dot{:}$CH *group.*—They render the hydrogen atom directly replaceable, and the compounds exist in the tautomeric forms $\dot{:}$CH·X$\dot{:}$Y and $\dot{:}$C$\dot{:}$X·YH.

(3.) *A* ·CH_2 *group.*—The compounds are usually capable of condensation with aldehydes, or of entering into the Claisen reaction with esters of oxalic, formic, and nitrous acids in presence of sodium ethoxide, that is to say, under conditions favourable to, if not actually productive of, the "iso"-forms of the compounds in question.

The connection between the foregoing facts is clearly brought out by the use of the mode of analysis suggested by the author (*Trans.*, 1898, **73**, 446).

The Claisen reaction is not applicable to nitrobenzene, in which there is no ·CH_2 group, but should, in accordance with the author's view of the function of the above groups when attached to a benzenoid nucleus (*loc. cit.*), be applicable to benzenoid compounds containing a ·CH_2 group in the *ortho-* or *para*-position to one of the groups in question.

Reissert (*Ber.*, 1897, **30**, 1030) states that whilst the methyl group of *o*- and *p*-nitrotoluene reacts with ethyl oxalate in presence of alcohol and sodium, no condensation occurs if ethyl nitrite is used. The author finds, however, that reaction occurs if alcohol-free sodium ethoxide and amyl nitrite are employed, and under these conditions *o*-nitrotoluene readily affords *o*-nitrobenzaldoxime, which on hydrolysis and treatment with potash and acetone yields indigo. *p*-Nitrotoluene also reacts, though less readily, with amyl nitrite, affording *p*-nitrobenzaldoxime. If amyl formate be used in these reactions, condensation appears to take place, but the products are more difficult to isolate.

The fact that *m*-nitrotoluene does not react in this respect like the *ortho-* and *para*-compounds is in strict accordance with the author's views. It is hoped that it will be possible to show that the other *meta*-orientating groups behave in the same manner as the nitro-group.

This occasion may be taken to point out that the application of recent views regarding the nature of unsaturated compounds (Thiele, *Annalen*, 1899, **306**, 87) to the case of substitution in the benzenoid series appears to lead inevitably to the conclusion, already arrived at by the author (*loc. cit.*), that substitution in the *meta*-position, relatively to one of the above groups, is probably preceded by the formation of a tautomeric compound analogous to the "iso"-forms of the nitro-, cyano-, and keto-paraffins.

ADDITIONS TO THE LIBRARY.

I. Donations.

Cross, C. F., E. J. Bevan, and C. Beadle. La Cellulose. Translated from the English edition of 1895 by R.-G. Lévy and M. Thomas. Paris 1900. From the Authors.

Miller, E. H. The calculations of analytical chemistry. New York 1900. From the Author.

Garçon, Jules. Répertoire général ou dictionnaire méthodique de bibliographie des industries tinctoriales et des industries annexes. Vol. I., premier fascicule. Paris 1900. From the Publishers.

Pamphlets.

Hartley, W. N. On the occurrence of cyanogen compounds in coal-gas, and of the spectrum of cyanogen in that of the oxy-coal-gas flame. (*Proc. Royal Dublin Soc.*, 1900, 9, III.)

Louis, D. A. Notes on gold and platinum mining in the Ural Mountains. (*Proc. Inst. of Mining and Metallurgy*, 1900, vol. viii.).

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June, Applications for Grants, to be made on forms which can be obtained on application to the Assistant Secretary, must be received on or before May 31st.

At the next meeting, on Thursday, May 17th, the following paper will be communicated by the authors:

"Chlorine derivatives of pyridine. VI. The orientation of some aminochloropyridines." By W. J. Sell, M.A., and F. W. Dootson, M.A.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 24/5/1900

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 224.

May 17th, 1900. Professor Thorpe, F.R.S., President, in the Chair.

Messrs. John R. Brooke, J. Wallace Sandford, and Bertram D. Steele were formally admitted Fellows of the Society.

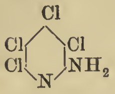
Certificates were read for the first time in favour of Messrs. Charles Berjew Brooke, Colne House, near Manningtree, Essex; Ernest Owen Courtman, Denford House, Atkin's Road, Clapham Park, S.W.; Henry Bertie Gritton, The Cottage, Balmain, Sydney, N.S.W., Australia; John Beresford Leathes, 10, Park Mansions, Battersea Park, S.W.; Sidney Scrivener Napper, 144, Highbury New Park, N.; Oswald Silberrad, Sunny Croft, Buckhurst Hill, Essex; John Traquair, Glenfield Starch Works, Paisley.

The following Certificates were approved by Council under Bye-law I (3):—Angelo Cantin, Vacoas, Mauritius; M. C. Nanjunda Row, Mylapore, Madras; M. Goolab Roy, Chintadrepettah, Madras.

Of the following papers, those marked * were read:—

*67. "The chlorine derivatives of pyridine. VI. The constitution of some aminochloropyridines." By W. J. Sell, M.A., and F. W. Dootson, M.A.

The authors gave an account of their work on the constitution of various aminotrichloro- and aminotetrachloro-pyridines which have recently been described by them. The two compounds, which result from the action of ammonia on pentachloropyridine (*Trans.*, 1898, 73, 777), and which melt at 174—175° and at 212—213°, are shown to have the constitutions represented by the formulæ I and II respectively.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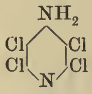
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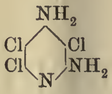
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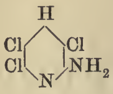
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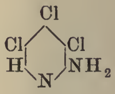

V.

Both compounds heated with ammonia to a higher temperature give the same diaminotrichloropyridine, which must therefore be represented by formula III.

To the aminotrichloropyridine, obtained by the action of ammonia on tetrachloroisonicotinic acid (*Trans.*, 1897, 71, 1083), the constitution represented by formula IV was provisionally assigned (*Trans.*, 1899, 75, 980). This has now been completely established.

The aminotrichloropyridine, obtained (*Trans.*, 1899, 75, 980) by the action of sodium carbonate on a compound containing two pyridine rings, was shown to have the constitution represented by formula V.

*68. "Ortho-substituted nitrogen chlorides and bromides, and the entrance of halogen into the ortho-position in the transformation of nitrogen chlorides." By F. D. Chattaway and K. J. P. Orton.

When phenylacetyl nitrogen chloride undergoes transformation, a mixture of *o*- and *p*-chloroacetanilide is produced in the proportion of 95—96 per cent. of the latter together with 4—5 per cent. of the former.

The following compounds were described:

Orthochlorophenylacetylnitrogen chloride (acetyl chloramino-2-chlorobenzene), $C_6H_4Cl{\cdot}NCl{\cdot}COCH_3$, colourless, long, flattened prisms, m. p. 88°.

Orthobromophenylacetylnitrogen bromide (acetyl bromamino-2-bromobenzene), $C_6H_4Br{\cdot}NBr{\cdot}COCH_3$, yellow, four-sided prisms, m. p. 150—152°.

Both of these compounds undergo transformation into the 2 : 4-disubstituted acetanilides.

DISCUSSION.

Dr. HEWITT pointed out that Beilstein and Kurbatow (*Annalen*, 1875, 176, 36) had separated the ortho- from the para-chloraniline by distilling the mixed sulphates with steam, this method being employed by them on account of the difficulty of isolating pure *o*-chloronitrobenzene from the mixture obtained on nitrating chlorobenzene.

Dr. Collie pointed out that if a compound were obtained in which the halogen was attached to a nitrogen atom which was not directly united to the benzene nucleus, it was possible that isomeric change involving the production of a meta-substitution product might result.

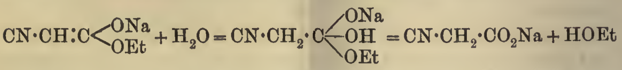
*69. "Ammonium imidosulphite." By Edward Divers and Masataka Ogawa.

The authors have discovered a compound, $3NH_3,2SO_2$, which has the constitution $HN(SO_2NH_4)_2$ and bears the same relation to the amidosulphite as that which exists between imidosulphate and amidosulphate. When ammonim amidosulphite is allowed to decompose completely in a current of well dried hydrogen or nitrogen at a temperature not exceeding 35°, it leaves a coloured residue which is practically insoluble in absolute alcohol. This residue, freely soluble in water, can (with the exception of a small quantity of sulphate) be dissolved by repeated treatments with alcohol of 90 per cent. Rejecting the coloured fractions first obtained, the remainder of the solution on evaporation over sulphuric acid deposits bright, micaceous crystals of the new salt *ammonium imidosulphite.* The mother liquor, which contains much ammonium amidosulphate must be removed by careful washing with 95 per cent. alcohol. The imidosulphite, is very deliquescent and all samples so far prepared have had an acid reaction towards litmus, due to the loss of a little ammonia. By dissolving the ammonium salt in 75 per cent. alcohol and adding exactly the equivalent quantity of alcoholic potash, the pure crystalline *potassium imidosulphite,* slightly alkaline to litmus, is obtained. The imidosulphites react with silver nitrate similarly to the amidosulphites and give with barium chloride a precipitate which readily dissolves in acids, forming a solution which acquires the odour of sulphur dioxide and deposits barium sulphate.

*70. "The constitution of ethyl sodiocyanacetate and of ethyl methylsodiocyanacetate." By Jocelyn Field Thorpe.

The author pointed out that the reactions of ethyl sodiocyanacetate and of ethyl methylsodiocyanacetate are best represented by the formulæ $\mathrm{CN{\cdot}CH{:}C(ONa)OEt}$ and $\mathrm{CN{\cdot}C(CH_3){:}C}{<}\begin{smallmatrix}\mathrm{ONa}\\ \mathrm{OEt}\end{smallmatrix}$ respectively.

When *ethyl sodiocyanacetate* is dissolved in water, the solution is not alkaline, and on evaporation in a vacuum, leaves sodium cyanacetate. The changes involved may be represented thus:



$$\mathrm{CN\cdot CH{:}C}{<}\begin{smallmatrix}\mathrm{ONa}\\ \mathrm{OEt}\end{smallmatrix} + \mathrm{H_2O} = \mathrm{CN\cdot CH_2\cdot C}\begin{smallmatrix}\mathrm{ONa}\\ \mathrm{OH}\\ \mathrm{OEt}\end{smallmatrix} = \mathrm{CN\cdot CH_2\cdot CO_2Na + HOEt}$$

The production of acid ethyl salts frequently observed in the condensation of ethyl cyanacetate with unsaturated ethyl salts can be thus explained, as the sodium compound of the condensation product, on treatment with water, would yield in a similar way the corresponding sodium ethyl salt. The acid ethyl salts on distillation lose carbon dioxide and pass into the corresponding nitriles.

A number of such condensations were described, and the conditions given under which the maximum quantity of acid ethyl salt is produced. Experiments were described showing that prolonging the time of heating increases the quantity of neutral ethyl salt at the expense of the acid ethyl salt. This is explained by assuming that the first step is the addition of a molecule of alcohol to the unsaturated sodium compound.

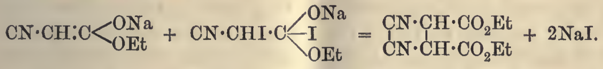
Ethyl methylsodiocyanacetate behaves in the same way as ethyl sodiocyanacetate, but its solubility and deliquescent nature render its purification difficult. It condenses with unsaturated ethyl salts to form acid ethyl salts, the yields of which, however, were never more than 17 per cent. of those theoretically possible.

The equation $\mathrm{CN\cdot CHNa\cdot CO_2Et + CH_2{:}CCH_3\cdot CO_2Et = CN\cdot CH(CO_2Et)\cdot CH_2\cdot CNa(CH_3)CO_2Et}$, usually supposed to represent a reaction of this kind, is shown to be wrong, because on treating the product of the reaction with methyl iodide, the ethyl salt obtained gives on hydrolysis the symmetrical $\alpha\alpha'$-dimethylglutaric acids, and not the unsymmetrical $\alpha\alpha$-dimethylglutaric acid.

Small quantities of *cis-* and *trans*-acids, such as are obtained from ethyl cyanacetate and ethyl methylcyanacetate, may be separated by the following method. The cyanoethyl salt is converted, by treatment with methyl alcoholic potash into the cyano-acid, which is then boiled with concentrated hydrochloric acid as long as carbon dioxide is evolved. The *cis-* and *trans*-amides, the intermediate products formed, are finally converted, the former into the imide, the latter into the *trans*-acid. The imide is insoluble in dilute sodium carbonate solution, and can thus be separated from the *trans*-acid.

*71. "The $\alpha\alpha_1\beta\beta$-tetramethylglutaric acids." By Jocelyn Field Thorpe and W. J. Young.

Ethyl sodiocyanacetate, $\mathrm{CN\cdot CH{:}C(ONa)OEt}$, separates from absolute alcohol in lustrous plates; with water it gives (see preceding abstract) sodium cyanacetate; with an ice cold solution of iodine in ether, it reacts to form *ethyl iodocyanacetate*, $\mathrm{CN\cdot CHI\cdot CO_2Et}$, a brown oil which decomposes on distillation under diminished pressure; an intermediate addition compound is, however, formed, which reacts with unchanged sodiocyanacetate at higher temperatures to form *ethyl dicyanosuccinate*, thus:



$$\mathrm{CN\cdot CH{:}C}{<}^{\mathrm{ONa}}_{\mathrm{OEt}} + \mathrm{CN\cdot CHI\cdot C}\begin{matrix}\diagup\mathrm{ONa}\\ -\mathrm{I}\\ \diagdown\mathrm{OEt}\end{matrix} = \begin{matrix}\mathrm{CN\cdot CH\cdot CO_2Et}\\ |\qquad |\\ \mathrm{CN\cdot CH\cdot CO_2Et}\end{matrix} + 2\mathrm{NaI}.$$

Ethyl dicyanosuccinate separates from dilute alcohol in glistening plates which melt at 120°.

With bromine dissolved in carbon bisulphide, only *ethyl bromocyanacetate*, $\mathrm{CN\cdot CHBr\cdot CO_2Et}$, was obtained as a brownish oil which decomposes on distillation under diminished pressure.

Ethyl methylsodiocyanacetate, $\mathrm{CN\cdot C(CH_3){:}C}{<}^{\mathrm{ONa}}_{\mathrm{OEt}}$, is not precipitated on the addition of alcoholic sodium ethoxide to ethyl methylcyanacetate, but is obtained as a gelatinous precipitate on adding an equal volume of dry ether to the solution. It combines with iodine to form *ethyl methyliodocyanacetate*, $\mathrm{CN\cdot C(CH_3)I\cdot CO_2Et}$, a brown oil decomposing on distillation under diminished pressure. It condenses with ethyl dimethylacrylate to give the acid salt, $\mathrm{CO_2H\cdot CH(CN)\cdot C(CH_3)_2\cdot CH(CH_3)\cdot CO_2Et}$, which, on distillation, loses carbon dioxide and gives *ethyl α-methyl-ββ-dimethyl-γ-cyanobutyrate*, $\mathrm{CN\cdot CH_2\cdot C(CH_3)_2\cdot CH(CH_3)\cdot CO_2Et}$, a fairly mobile oil boiling at 224°, which, on hydrolysis, gives αββ-trimethylglutaric acid melting at 87°. The preparation of *ethyl α-cyano-αα₁ββ-tetramethyl glutarate*, b. p. 174—176°, and its conversion into *tetramethyl glutarimide* (m. p. 108°), and into trans-*αββα′-tetramethyl glutaric acid* (m. p. 98°) are described. The imide is converted by heating for 2 hours with 50 per cent. sulphuric acid into the *cis*-acid which melts at 140°, and this, on treatment with acetyl chloride yields its anhydride, a liquid boiling at 155—160° (30 mm.). The *cis*-acid is partially converted into the *trans*-acid by heating it in a sealed tube with concentrated hydrochloric acid.

*72. "β-Isopropylglutaric acid, and the *cis*- and *trans*-methyl isopropyl glutaric acids." By F. H. Howles, J. F. Thorpe, and W. Udall.

The main facts regarding β-isopropylglutaric acid have already been described (*Proc.*, 1899, 15, 103).

By the action of methyl iodide on the sodium compound of the product resulting from the condensation of ethyl sodiocyanacetate with ethyl β-isopropylacrylate, *ethyl α-cyano-α-methyl-β-isopropyl glutarate* is obtained as a thick oil boiling at 180—183° (25 mm.). This on hydrolysis with methyl alcoholic potash yields the corresponding *potassium* salt, from the acidified aqueous solution of which the solid cyano-acid may be obtained; this, on boiling with concentrated hydrochloric acid, passes into a mixture of the imide and the *trans*-acid. *α-Methyl-β-isopropyl glutarimide* separates from water in colourless needles melting at 114—115°. Trans-*α-methyl-β-isopropyl glutaric acid* separates from water in microscopic crystals melting at 102°, and is converted into the anhydride of the *cis*-modification on heating with acetic anhydride in a sealed tube.

The *cis*-modification (obtained from the imide by heating with 50 per cent. sulphuric acid) crystallises from water in glistening plates melting at 137°, and on treatment with acetic anhydride is converted into the anhydride which crystallises from light petroleum in prisms melting at 44°.

Ethyl sodiocyanacetate condenses with ethyl α-methyl acrylate to form the acid ethyl salt, $CO_2H\cdot CH(CN)\cdot CH_2\cdot CH(CH_3)\cdot CO_2Et$, which on distillation yields *ethyl α-methyl-γ-cyanobutyrate,* a mobile oil boiling at 205°, giving on hydrolysis α-methylglutaric acid.

By a similar method to that above described *ethyl α-cyano-αα′-dimethylglutarate* (b. p. 181—183°), the *potassium salt* of the cyano-acid, the *cyano-acid* and the cis- and trans-*αα′-dimethylglutaric acids* were prepared.

Ethyl β-methyl-γ-cyanobutyrate and *β-methylglutaric acid* have also been obtained in a similar manner.

*73. "The racemisation of optically active tin compounds. Dextromethylethylpropyl tin dextrobromocamphorsulphonate." By William Jackson Pope and Stanley John Peachey.

The authors have shown (*Proc.*, 1900, **16**, 42) that the aqueous solution obtained by treating externally compensated methylethyl-*n*-propyl tin iodide with aqueous silver dextrocamphorsulphonate yields only dextromethylethylpropyl tin dextrocamphorsulphonate on evaporation to dryness. They attributed this behaviour to progressive racemisation of the lævorotatory radicle, $(CH_3)(C_2H_5)(C_3H_7)Sn\cdot$, attending crystallisation of the sparingly soluble salt of the dextrorotatory radicle. As this, the first well-determined case of the kind recorded, has an important bearing upon the space configuration of quadrivalent sulphur compounds (*Proc.*, 1900, **16**, 12), and upon the preparation of compounds owing their optical activity to the asymmetric nitrogen atom (*Trans.*, 1899, **75**, 1127), it seemed to merit further investigation.

On treating externally compensated methylethyl-*n*-propyl tin iodide with silver dextro-α-bromocamphorsulphonate in warm aqueous solution and evaporating the filtered liquid, *dextromethylethylpropyl tin dextrobromocamphorsulphonate*, $(CH_3)(C_2H_5)(C_3H_7)Sn(C_{10}H_{14}BrOSO_3)$, separates in colourless plates which, after crystallisation from acetone, melt at 194—197° with previous softening; the mother liquors yield, on evaporation, further deposits of the same salt and no trace of salt of the lævorotatory base could be obtained. The behaviour of the dextrocamphorsulphonate and the dextrobromocamphorsulphonate is thus the same, the whole of the lævorotatory base, $(CH_3)(C_2H_5)(C_3H_7)Sn{\cdot}OH$, becoming converted into its dextrorotatory isomeride. In dilute aqueous solution, the bromocamphorsulphonate has the molecular rotation $+318°$, which, accepting Walden's value, $[M]_D = +270°$, for the bromocamphorsulphonic acid radicle, allows $[M]_D = +48°$ for the basic radicle; the value, $[M]_D = +45°$, previously obtained from the dextrocamphorsulphonate is thus confirmed.

A crucial test of the truth of the explanation based on progressive racemisation is now possible, for if the intramolecular mobility of the base, $(CH_3)(C_2H_5)(C_3H_7)SnOH$, is such that racemisation can effect total conversion of the externally compensated base into the dextrorotatory component, the reverse should occur under favourable conditions. A one per cent. aqueous solution of the crystalline dextrobromocamphorsulphonate was made in the cold, and the molecular rotation of the dissolved salt was found to be $+318°$. The solution was then sealed up in a tube and heated on the water-bath for 2 hours; after cooling, the molecular rotation was found to be now only $+273°$. As the molecular rotation of the acid is $+270°$, the base must exist wholly racemised in the solution. Some of the solution was then evaporated to dryness on the water-bath, and, after cooling, made up to its original volume by dissolving the residue in cold water; the molecular rotation of the salt in this solution had risen to $+315°$ This experiment was repeated with similar results. Further, the addition of potassium iodide solution to aqueous solutions of dextromethylethylpropyl tin dextrobromocamphorsulphonate before and after heating on the water-bath caused the deposition of dextrorotatory and of optically inactive methylethylpropyl tin iodide respectively.

These facts afford the complete proof that on evaporating externally compensated methylethylpropyl tin hydroxide with either of the optically active acids, the lævo-base is wholly converted into the dextrocomponent by progressive racemisation.

DISCUSSION.

Prof. PERCY FRANKLAND called attention to the remarkable mobility of the groups attached to the atom of tin which was quite without parallel in the case of groups attached to carbon. In no asymmetric carbon compound with which he was acquainted had anything comparable to this facility of racemisation been observed.

74. "Racemic and optically active forms of isoamarine." By H. Lloyd Snape, D.Sc., Ph.D.

The author has examined the behaviour of the isoamarine previously described by Brooke and himself (*Trans.*, 1899, 75, 208) towards nitrous acid, alkyl iodides, acetyl chloride, and nitric acid. Each of these agents acts upon ordinary amarine: and it was desired to contrast the products obtained from the two bases. But, although isoamarine entered readily into reaction in every case, the products were so unstable that as yet the author has failed to prepare them in pure condition.

As the result of further investigation, the anticipation of Japp and Moir (*Trans.*, 1900, 77, 613) that isoamarine is the racemic form of amarine was fully confirmed. Isoamarine, itself optically inactive, was resolved by means of tartaric acid into the acid tartrates, $C_{21}H_{18}N_2 \cdot C_4H_6O_6, 2H_2O$, of the *d*- and *l*-bases, the salt of the *d*-base being much less soluble than that of the *l*-isomeride. From the respective tartrates, the corresponding bases were obtained by precipitation with ammonia. The *l*-base was more difficult to obtain in a state of purity; but it was evident that the optical antipodes had been obtained, the one giving for $[\alpha]_D$ $+62{\cdot}02°$, and the other $-61{\cdot}30°$ to $-58{\cdot}65°$, these values being determined in ethyl acetate solution, after the rotation had become constant.

The racemic base has a higher melting point and density, but a smaller solubility, than the optical antipodes.

Mr. W. J. Pope has kindly measured the crystals of *d*- and *l*-isoamarine, and states that they are orthorhombic prisms, sphenoidally hemihedral, the crystals of the *d*-base showing the form $O\ -k\{111\}$, whilst those of the *l*-isomeride show the form $O\ +k\{111\}$. The crystals of the two substances are thus enantiomorphously related.

The racemic base was synthesised from the *d*- and *l*-isomerides by mixing them in alcoholic solution; but neither of the latter was racemised when heated alone with alcohol to 200°.

ADDITIONS TO THE LIBRARY.

I. Donations.

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RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June, Applications for Grants, to be made on forms which can be obtained on application to the Assistant Secretary, must be received on or before May 31st.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 13/6/1900

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 225.

June 7th, 1900. Professor Thorpe, C.B., F.R.S., President, in the Chair.

Messrs. T. G. Joyce, A. W. Bain, T. FitzGibbon, and B. Jordan-Smith were formally admitted Fellows of the Society.

The following certificate was read for the first time:—Edmund Foster Hudson, Churcher's College, Petersfield, Hants.

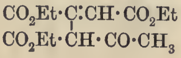
Professor Dunstan, on behalf of the Society, congratulated the President on the distinction recently conferred upon him by Her Majesty.

The President returned his thanks to the Society for their congratulations.

Of the following papers, those marked * were read:—

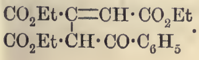
*75. "Condensation of ethyl acetylenedicarboxylate with bases and β-ketonic esters." By S. Ruhemann and H. E. Stapleton.

The esters previously obtained (*Trans.*, 1896, 69, 530, 1383; 1897, 71, 323) by the action of ethyl acetoacetate and ethyl benzoylacetate on ethyl chlorofumarate had been formulated thus:



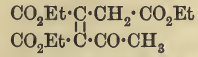
$$\begin{array}{l} CO_2Et\cdot C{:}CH\cdot CO_2Et \\ CO_2Et\cdot CH\cdot CO\cdot CH_3 \end{array}$$

and



$$\begin{array}{l} CO_2Et\cdot C{=}CH\cdot CO_2Et \\ CO_2Et\cdot CH\cdot CO\cdot C_6H_5 \end{array}.$$

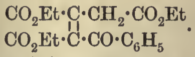
These esters were found by the authors to be identical with those which are formed by using ethyl acetylenedicarboxylate instead of ethyl chlorofumarate (*Trans.*, 1899, **75**, 784). The considerations brought forward (*Trans.*, 1900, **77**, 242) led to the conclusion that these esters should be represented by the formulæ:



$$\begin{array}{l} CO_2Et\cdot C\cdot CH_2\cdot CO_2Et \\ \quad\quad\quad\ \Vert \\ CO_2Et\cdot C\cdot CO\cdot CH_3 \end{array}$$

Ethyl acetoaconitate.

and

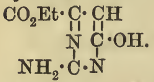


$$\begin{array}{l} CO_2Et\cdot C\cdot CH_2\cdot CO_2Et \\ \quad\quad\quad\ \Vert \\ CO_2Et\cdot C\cdot CO\cdot C_6H_5 \end{array}.$$

Ethyl benzoylaconitate.

The latter expressions are in harmony with the facts that these esters do not give a coloration with ferric chloride and that the same substances are produced by using chlorofumaric and chloromaleic esters (*Trans.*, 1896, **69**, 530).

The difference in the behaviour of ethyl acetylenedicarboxylate from that of ethyl phenylpropiolate is also found in its reactions with guanidine and benzamidine. The former base yields with it a cyclic compound which has both basic and acidic properties, and is regarded by the authors as ethyl amidohydroxypyrimidinecarboxylate,



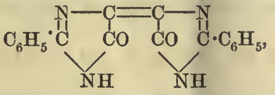
$$\begin{array}{l} CO_2Et\cdot C\cdot CH \\ \quad\quad\quad\ \ \Vert\quad \Vert \\ \quad\quad\quad\ \ N\quad C\cdot OH. \\ \quad\quad\quad\ \ |\quad\ | \\ \ \ NH_2\cdot C\cdot N \end{array}$$

This ester, on boiling with potassium hydroxide, hardly undergoes any change beyond hydrolysis to the corresponding acid.

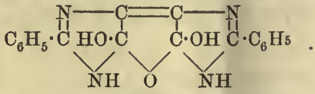
Quite unexpected is the reaction of benzamidine with ethyl acetylenedicarboxylate, which takes place thus:

$$2C_6H_5\cdot C{<}^{NH}_{NH_2} + CO_2Et\cdot C⋮C\cdot CO_2Et = C_{18}H_{12}N_4O_2 + EtOH + H_2$$

(the hydrogen probably effects a reduction), producing ruby-red crystals of a substance called *glyoxaline red*. Its constitution is probably



which indicates the close relationship of this compound to indigo and pyrazole blue. Glyoxaline red, when boiled with glacial acetic acid, takes up one molecule of water, and is transformed into a substance, $C_{18}H_{14}N_4O_3$, crystallising in yellow needles, for which the authors suggest the formula

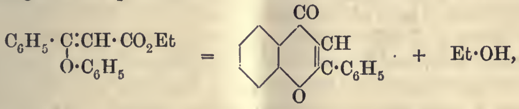


This compound dissolves in potassium hydroxide, forming a yellow solution which, gradually acquires the red violet colour of the alkaline solution of glyoxaline red.

The authors have found that the same substances are formed from guanidine as well as from benzamidine by using ethyl chlorofumarate instead of ethyl acetylenedicarboxylate.

*76. "Condensation of phenols with ethyl phenylpropiolate." By S. Ruhemann and F. Beddow.

The ease with which the esters of the acetylene series form additive products induced the authors to study their behaviour towards phenols. They find that the sodium phenoxides readily combine with ethyl phenylpropiolate to form aryl derivatives of ethyl β-hydroxycinnamate; thus in the case of sodium phenoxide itself the following reaction takes place, $C_6H_5\cdot C\vdots C\cdot CO_2Et + C_6H_5\cdot OH = C_6H_5\cdot \underset{\displaystyle O\cdot C_6H_5}{\underset{|}{C}}\vdots CH\cdot CO_2Et$. It was hoped that these esters might be converted into flavone and its derivatives, according to the equation:



$$C_6H_5\cdot \underset{\displaystyle O\cdot C_6H_5}{\underset{|}{C}}\vdots CH\cdot CO_2Et = \ldots + Et\cdot OH,$$

but up to the present this has not been accomplished, because the esters are so easily hydrolysed to the corresponding acids, whilst the acids themselves, on heating, lose carbon dioxide and yield phenoxystyrene, $C_6H_5\cdot \underset{\displaystyle O\cdot C_6H_5}{\underset{|}{C}}\vdots CH_2$, and its homologues; further, on warming phenoxystyrene with dilute acids, it decomposes into acetophenone and phenol, thus, $C_6H_5\cdot \underset{\displaystyle O\cdot C_6H_5}{\underset{|}{C}}\vdots CH_2 + H_2O = C_6H_5\cdot CO\cdot CH_3 + C_6H_5\cdot OH$. The homologues of phenoxystyrene decompose in a similar manner.

The authors found that ethyl phenylpropiolate reacts with the sodium derivatives of *o*- and *p*-cresol to form compounds analogous to those obtained with sodium phenoxide. The α- and β-naphthols also react in a similar manner with the ester, and form the ethyl esters of the naphthoxycinnamic acids, thus from α-naphthol ethyl α-naphthoxycinnamate and the corresponding acid were prepared; this acid seems to be less stable than those obtained from phenol and the cresols, as it undergoes decomposition when left in contact with dilute sulphuric acid, acetophenone being produced.

*77. "The constitution of pilocarpine." By H. A. D. Jowett, D.Sc

In a recent paper (*Trans.*, 1900, 77, 494), the author gave an account of some preliminary experiments on isopilocarpine, and reserved the question of the constitution of the alkaloid for a future paper. Owing to the publication of a paper on pilocarpine by Pinner and Kohlhammer (*Ber.*, 1900, **33**, 1424), the author has deemed it advisable to give a brief account of the results he has thus far obtained.

Action of Fused Potash on Isopilocarpine.—It was shown (*loc. cit.*) that ammonia, methylamine, and an acid, probably isobutyric, were formed in this reaction. It has now been proved that isobutyric acid is formed, in addition to other acids which are produced in quantity too small to be identified.

Distillation of Pilocarpine with Soda Lime.—A preliminary experiment had shown that the bases formed in this reaction are ammonia and either 2- or 3-methylpyridine. Further investigation has shown that, in addition, methylamine is formed, and that only a very small quantity of 3-methylpyridine is produced. As the formation of traces of a pyridine base by distillation with soda lime, does not throw very much light on the constitution of the alkaloid, this reaction has not been further investigated.

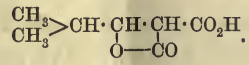
Oxidation of Isopilocarpine by Potassium Permanganate.—The oils previously mentioned have now been examined, and it has been proved that the products of oxidation, besides ammonia and methylamine, are acetic acid and an acid having the formula $C_7H_{10}O_4$. The quantity of permanganate required for the oxidation is about 6 molecular proportions, and the reaction may be expressed by the following equation: $C_{11}H_{16}O_2N_2 + 7O + H_2O = NH_3 + CH_3NH_2 + C_7H_{10}O_4 + 3CO_2$.

The new acid was obtained as the ethyl ester, and the yield was 70 per cent. of the theoretical. The acid is a very slightly coloured, yellow oil, with a peculiar smell, and boils at 210—220° at 10 mm. pressure. By titration, it was shown to be a lactonic acid.

The ethyl ester, $C_9H_{14}O_4$, boils at 299° at atmospheric pressure, is optically active, $[\alpha]_{D}^{15^\circ} = +30{\cdot}76^\circ$, and has a specific gravity 1·1053 (15°/15°).

The ethyl ester reacts with phosphorus pentabromide, yielding the bromethyl ester, which was isolated as an oil boiling at 165—170° (20 mm.). This was treated with diethylaniline, and the unsaturated ethyl ester, boiling at 155° (10 mm.) hydrolysed, when an acid was obtained which boiled at 180—200° (10 mm.), and answered Baeyer's test for an unsaturated acid. It was now oxidised, first with cold permanganate, and then with chromic acid, to an acid which was proved by analysis of the crystalline silver salt to be isobutyric acid.

The probable formula for the lactonic acid is therefore



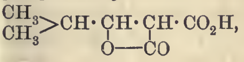
$$\begin{matrix}CH_3\\CH_3\end{matrix}\!>CH\cdot\underset{\underset{O\,-}{|}}{C}H\cdot\underset{\underset{-\,CO}{|}}{C}H\cdot CO_2H.$$

Action of Methyl Iodide on Isopilocarpine.—When isopilocarpine methiodide is heated with potash solution in a sealed tube, the base formed is methylamine, thus proving that the nitrogen atom to which pilocarpine owes its basic character is the one eliminated in various reactions as ammonia. By treatment with silver hydroxide and subsequent heating, a new base is formed—*methylisopilocarpine*—which is insoluble in chloroform and forms a crystalline platinichloride, m. p. 218°, and a crystalline picrate, m. p. 136°. This base reacts with methyl iodide to form a methiodide, from which, however, by treatment with silver hydroxide, the original base—methylisopilocarpine—is obtained. It was not found possible to introduce more than one methyl group. Methylisopilocarpine methiodide, on heating with potash solution in a sealed tube, yields only one base—methylamine. These experiments prove the existence of the group $:NH$ in isopilocarpine, and, since the other nitrogen atom always yields methylamine, it must occur as the group $:NCH_3$. Herzig and Meyer have stated that one methyl group is attached to a nitrogen atom, and Chastaing was unable to prepare dialkyl derivatives.

Without proposing any formula for isopilocarpine, it may be desirable to state the facts which any formula for the base must explain :

1. The optical behaviour of pilocarpine and isopilocarpine, and the remarkable stability of the latter base towards heat, alkalis, and various chemical reagents.

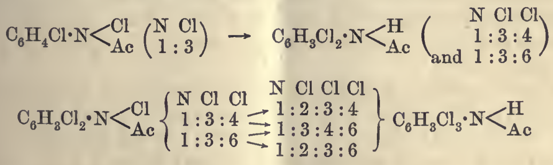
2. The non-basic character of the group $:NCH_3$.

3. The existence of the groups 
$\genfrac{}{}{0pt}{}{CH_3}{CH_3}{>}CH\cdot\underset{\underset{O\text{——}}{|}}{C}H\cdot\underset{\underset{CO}{|}}{C}H\cdot CO_2H$,

$:NH$, and $:NCH_3$.

*78. "The nitrogen chlorides derivable from meta-chloro-acetanilide and their transformations." By F. D. Chattaway, K. J. P. Orton, and W. H. Hurtley.

The action of hypochlorous acid on meta-chloro-acetanilide was described. The nitrogen chlorides formed and the transformations they undergo are represented by the following scheme :



$$C_6H_4Cl\cdot N{<}^{Cl}_{Ac}\left(\begin{matrix}N & Cl\\ 1: & 3\end{matrix}\right) \rightarrow C_6H_3Cl_2\cdot N{<}^{H}_{Ac}\left(\begin{matrix}N\ Cl\ Cl\\ 1:3:4\\ \text{and }1:3:6\end{matrix}\right)$$

$$C_6H_3Cl_2\cdot N{<}^{Cl}_{Ac}\left\{\begin{matrix}N\ Cl\ Cl\\ 1:3:4\\ 1:3:6\end{matrix}\right.\begin{matrix}\\ \rightarrow\\ \rightrightarrows\\ \rightarrow\end{matrix}\left.\begin{matrix}N\ Cl\ Cl\ Cl\\ 1:2:3:4\\ 1:3:4:6\\ 1:2:3:6\end{matrix}\right\}C_6H_3Cl_3\cdot N{<}^{H}_{Ac}$$

Each of the three tri-chloro-acetanilides yields nitrogen chlorides, which change into the same tetra-chloro-acetanilide (NH : Cl : Cl : Cl : Cl =

1 : 2 : 3 : 4 : 6). In the transformation of these nitrogen chlorides in which one meta-position is occupied, the formation of the ortho-derivatives takes place to a greater extent than in the transformation of the nitrogen chlorides derived from acetanilide (*Proc.*, 1900, **16**, 112). The transformation is also a much slower and more difficult process.

The following substances are described :

Metachlorophenylacetylnitrogen chloride (acetylchloramino-3-chlorobenzene), $C_6H_4Cl \cdot NCl \cdot COCH_3$. Clusters of small prisms, m. p. 93°.

3 : 4-*Dichlorophenylacetylnitrogen chloride* (acetylchloramino-3 : 4-dichlorobenzene), $C_6H_3Cl_2 \cdot NCl \cdot COCH_3$. Clusters of very slender prisms, m. p. 92°.

2 : 5-*Dichlorophenylacetylnitrogen chloride* (acetylchloramino-2 : 5-dichlorobenzene), $C_6H_3Cl_2 \cdot NCl \cdot COCH_3$. Small prisms, m. p. 73°.

2 : 3 : 4-*Trichlorophenylacetylnitrogen chloride* (acetylchloramino-2 : 3 : 4-trichlorobenzene), $C_6H_2Cl_3 \cdot NCl \cdot COCH_3$. Clusters of flattened prisms, m. p. 113—114°.

2 : 4 : 5-*Trichlorophenylacetylnitrogen chloride* (acetylchloramino-2 : 4 : 5-trichlorobenzene), $C_6H_2Cl_3 \cdot NCl \cdot COCH_3$. Rosettes of short, thick prisms, m. p. 96°.

2 : 3 : 6-*Trichlorophenylacetylnitrogen chloride* (acetylchloramino-2 : 3 : 6-trichlorobenzene), $C_6H_2Cl_3 \cdot NCl \cdot COCH_3$. Small, four-sided prisms or plates, m. p. 116°.

2 : 3 : 4 : 6-*Tetrachlorophenylacetylnitrogen chloride* (acetylchloramino-2 : 3 : 4 : 6-tetrachlorobenzene), $C_6H_2Cl_4 \cdot NCl \cdot COCH_3$. Clusters of small prisms, m. p. 97°.

*79. "The persulphuric acids." By T. Martin Lowry, D.Sc., and John H. West.

This work was undertaken in order to elucidate the part which 'persulphuric acid' plays in the accumulator (Armstrong and Robertson, *Proc. Roy. Soc.*, 1891, **50**, 105) and to ascertain to what extent the production of this acid must be taken into account in discussing the electric conductivity of solutions of sulphuric acid, as well as in determining the origin of the products which such solutions yield when electrolysed under various conditions (Armstrong, *Trans.*, 1895, **67**, 1156).

In the course of the inquiry it became necessary to repeat and extend Berthelot's observations on the interaction of hydrogen peroxide and sulphuric acid (*Ann. Chim. Phys.*, 1878, [v], 14, 345—354). The experiments have led to results which appear to have an important bearing on the constitution of the product formed by the interaction of sulphuric acid and potassium persulphate, which Caro (*Zeit. angew.*

Chem., 1898, 4, 845) has shown to be possessed of special properties, and which Bamberger as well as v. Baeyer and Villiger have made use of as an oxidising agent under the name of "Caro's reagent." It has been suggested by v. Baeyer and Villiger that the acid characterised by Caro is a 'persulphuric' acid composed of hydrogen peroxide and sulphuric anhydride in the ratio $H_2O_2 : SO_3$. The authors' experiments favour the conclusion that its composition may be $H_2O_2 : 4SO_3$; the acid of which salts were first prepared by Marshall, being of intermediate composition—$H_2O_2 : 2SO_3$. The members of such a series of persulphuric acids may be provisionally distinguished as 'persulphuric,' 'perdisulphuric' and 'pertetrasulphuric acids.'

Evidence of the composition of the acid in question has been obtained by determining the equilibrium which results on mixing solutions of sulphuric acid and hydrogen peroxide in various proportions. Over fifty different mixtures have been examined, and it has been found that the variation of equilibrium as the concentration changes can be represented by an equation of the type $\frac{c_1}{c_2} = k_1\left(\frac{c_3}{c_4}\right)^2 + k_2\left(\frac{c_3}{c_4}\right)^4$ where c_1 and c_2 are the relative molecular concentrations of the 'persulphuric' acid and hydrogen peroxide, whilst c_3 and c_4 are the relative molecular proportions of sulphuric acid and water in the mixture. The peroxidation is effected almost entirely within the limits H_2SO_4 and $H_2SO_4,5H_2O$. The results indicate that in addition to the 'pertetrasulphuric' acid, a small but increasing proportion of 'perdisulphuric' acid is formed as the concentration decreases, and qualitative tests made in accordance with Caro's directions leave no doubt that this is the case.

80. "On diphenyl- and dialphyl-ethylenediamines, their nitro-derivatives, nitrates, and mercurichlorides." By W. S. Mills, B.A.

When diphenylethylenediamine dissolved in glacial acetic acid is nitrated, a yellow precipitate is obtained towards the completion of the nitration. Purified from nitrobenzene, it melts at 307—308°, and is the *tetranitrodiphenylethylenediamine*, $C_2H_4(NHC_6H_3(NO_2)_2)_2$, of Jedlicka (*J. pr. Chem.*, 1893, [ii], 48, 202), prepared by the interaction of 2:4-bromodinitrobenzene and ethylenediamine.

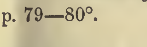
Water added to the solution from which the last-mentioned compound has separated precipitates a yellow, amorphous powder very soluble in acetone, ethyl acetate, and acetic acid. It melts at 85°, and is an *isomeric tetranitrodiphenylethylenediamine*, which, when boiled with acetone, is converted into Jedlicka's isomeride.

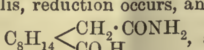
Diorthotolylethylenediamine nitrated in a similar manner gives a solution from which water precipitates a yellow, amorphous powder, which melts at 78—79°; it is a *tetranitrodiorthotolylethylenediamine*, $C_2H_4(NHC_6H_2{\cdot}2NO_2{\cdot}CH_3)_2$. When heated with ethyl acetate, this compound undergoes a change similar to that observed in the case of its phenyl homologue, a yellow powder being obtained which melts at 178—180°, and is probably an *isomeric tetranitrodiorthotolylethylenediamine.* Dimetatolylethylenediamine on nitration gives a yellow powder very soluble in acetic acid, melting at 57°, and is *tetranitrometatolylethylenediamine.* Partial nitration of diparatolylethylenediamine gives a mass of fine, orange-red crystals. This is *dinitrodiparatolylethylenediamine*, $C_2H_4(NHC_6H_3{\cdot}NO_2{\cdot}CH_3)_2$, melting at 195—196° and is identical with that prepared by Gattermann and Hager (*Ber.*, 1884, **17**, 778) by the interaction of ethylene dibromide and metanitroparatoluidine.

Diphenylethylenediamine nitrate, $C_2H_4(NHC_6H_5)_22HNO_3$, consists of needle-shaped crystals m. p. 164·5°. *Diorthotolylethylenediamine-nitrate*, $C_2H_4(NHC_6H_4CH_3)_22HNO_3$, needles, m. p. 152°. *Diparatolylethylenediamine nitrate*, needles, m. p. 166·5°. *Dimetatolylethylenediamine nitrate*, needles, m. p. 153°.

The mercurichlorides are prepared by adding alcoholic solutions of mercuric chloride to alcoholic solutions of the bases in molecular proportions, when crystalline precipitates separate slowly on standing, except in the case of the metatolyl compound, which is obtained by spontaneous evaporation of the mixed solutions. *Diphenylethylenediaminemercurichloride*, $C_2H_4(NHC_6H_5)_2HgCl_2$, well formed rhombic plates, m. p. 129°. *Diorthotolylethylenediamine mercurichloride*, small rhombic plates, m. p. 110°. *Diparatolylethylenediamine mercurichloride*, in white, feathery flakes, m. p. 133°. *Dimetatolylethylenediaminemercurichloride*, rosettes needles, m. p. 79—80°.

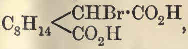
81. "Derivatives of cyanocamphor and homocamphoric acid." By Arthur Lapworth.

Cyanocamphor is easily obtained in large quantities by a modification of the method of Bishop, Claisen, and Sinclair (*Annalen*, 1894, **281**, 351). *Chlorocyanocamphor*,  $C_8H_{14}<\begin{matrix}CCl{\cdot}CN\\ |\\ CO\end{matrix}$, crystallises in brilliant prisms melting at 98—100°. Cyanocamphor and its bromo- and chloro-derivatives are dimorphous.

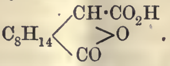
When the halogen derivatives of cyanocamphor are heated with strong aqueous alkalis, reduction occurs, and cyanocamphor and *homocamphoramic acid*,  $C_8H_{14}<\begin{matrix}CH_2{\cdot}CONH_2\\ CO_2H\end{matrix}$, are produced. The latter crystallises in large prisms which melt and decompose at 209—210°.

Homocamphoric acid crystallises well from nitrobenzene, forming beautiful, white needles which are apparently uniaxial.

When homocamphoric acid is heated with bromine in a sealed tube, action occurs at 140°, but much more than 1 molecular proportion of bromine is used up, and the products are difficult to isolate. When it is brominated in presence of phosphorus pentabromide and the product is treated with alcohol, diethylaniline, and alcoholic potash successively, a *lactone*, $C_{10}H_{16}O_2$, is obtained; this is volatile with steam and crystallises in colourless needles melting at 146°.

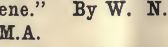
a-Bromohomocamphoric acid,  $C_8H_{14}<\substack{CHBr\cdot CO_2H\\ CO_2H}$, is made by heating the dichloride of homocamphoric acid with bromine on the water-bath. It separates from ethyl acetate in small, six-sided leaflets, and from benzene in slender needles. It melts sharply, under certain conditions, at 181—182°. Unlike all the allied substances, namely, camphoric acid and its halogen derivatives, and homocamphoric acid itself, it dissolves in chloroform and benzene.

When its diethyl ester is heated with diethylaniline, it loses ethyl bromide, and gives the ethyl ester of *homocamphanic acid,*



$$C_8H_{14}\left<\begin{matrix}CH\cdot CO_2H\\ \quad >O\\ CO\end{matrix}\right. .$$

The same acid is obtained by warming an aqueous solution of sodium bromohomocamphoric acid; it crystallises in glistening needles or six-sided plates melting at 161—162°.

Experiments are being made with the object of preparing *dehydrohomocamphoric acid,*  $C_8H_{13}<\substack{CH\cdot CO_2H\\ CO_2H}$, which should afford interesting results on oxidation.

82. "The ultra-violet absorption spectra of some closed chain carbon compounds. II. Dimethylpyrazine, hexamethylene, and tetrahydrobenzene." By W. N. Hartley, F.R.S., and Jas. J. Dobbie, D.Sc., M.A.

It was shown by the authors that dimethylpyrazine, a substance representing a group not hitherto examined spectroscopically, possesses a banded spectrum, the absorption band being both wider and more persistent than that of pyridine. This result was anticipated from the analogy of the constitution of this substance with that of benzene and pyridine. It affords further evidence of the intimate connection between the phenomenon of selective absorption and the benzenoid structure.

The result is further interesting in connection with the question of the constitution of cyanuric acid (*Trans.*, 1882, 41, 48). While pyridine contains the group ·C⋮N· once in the benzene structure, dimethylpyrazine contains it twice, and the formula originally proposed for cyanuric acid contains it three times. Accordingly, if this formula were correct for cyanuric acid, we should expect that it would exhibit a powerful absorption band more intense than that of pyrazine. It has, however, been recently shown (Hartley, *Proc.*, 1899, 15, 46) that cyanuric acid has no absorption band.

Specimens of pure hexamethylene and tetrahydrobenzene, prepared by Professor Sydney Young and Miss Fortey, and kindly lent by them, were found to be much more highly diactinic than benzene, and showed no trace of selective absorption. This result confirms the conclusion, previously drawn from the examination of such substances as hexachlorobenzene and piperidine (*Phil. Trans.*, 1885, Part II), that with reduction of the benzene ring the substances are no longer characterised by an absorption band, but by a continuous spectrum indicating a less compact form of linking within the nucleus of the carbon atoms or of the carbon and nitrogen.

83. "A study of the absorption spectra of *o*-oxycarbanil and its alkyl derivatives in relation to tautomerism." By W. N. Hartley, F.R.S., Jas. J. Dobbie, D.Sc., M.A., and Photios G. Paliatseas.

Two ethyl derivatives of *o*-oxycarbanil $C_7H_5NO_2$ are known. One of these is prepared directly from *o*-oxycarbanil by boiling it with equivalent quantities of ethyl iodide and alcoholic potash. This ether is considered to have the lactam constitution, because when heated with hydrochloric acid it takes up water and decomposes into carbon dioxide and the hydrochloride of ethyl-*o*-amido-phenol. The other ether, which is obtained by the interaction of *o*-amido-phenol and ethyl imido-carbonate yields oxycarbanil on treatment with strong hydrochloric acid and is therefore a lactime. The chemical evidence leaves it undecided whether *o*-oxycarbanil itself possesses the lactam or the lactime structure. On photographing the absorption spectra of the three compounds it was found that the spectra of *o*-oxycarbanil are almost identical with those of the lactam ether. The amount of general absorption is practically the same in both cases and the absorption band, which is well marked and persistent, occupies the same position in the spectra of both substances. The spectra of the lactime ether show a smaller amount of general absorption and the absorption band is much less persistent. From the similarity between the spectra of *o*-oxycarbanil and the lactam ether, it is inferred that the parent substance in this case, as in the cases of isatin and carbostyril (*Trans.*, 1899, 75, 640), possesses in solution the ketonic structure or, if the solution be a mixture of tautomeric modifications, that the ketonic modification predominates almost to the exclusion of the enolic.

84. "Action of formaldehyde on amines of the naphthalene series. II." By G. T. Morgan, D.Sc.

By the action of formaldehyde on ethyl-β-naphthylamine, 2 : 2-*diethyldiamino*-1 : 1-*dinaphthylmethane*, melting at 197—198°, is obtained when the reaction is carried out in cold glacial acetic acid, but when the condensation is effected in hot alcoholic solutions in the presence of hydrogen chloride, it is accompanied by a *compound*, $C_{23}H_{19}NO$ (m. p. 157—158°).

2 : 2-*Dibenzoyldiethyl*-1 : 1-*dinaphthylmethane*, produced from the preceding diamine by the Schotten-Baumann reaction, melts at 196°.

1 : 1-*Tetramethyldiaminodinaphthylmethane*, prepared from dimethyl-α-naphthylamine, melts at 177°; unlike its benzenoid analogue, tetramethyldiaminodiphenylmethane, it does not yield a colour base on treatment with lead peroxide.

Further investigation of the methylene bases derived from 1-bromo-2-naphthylamine and 1-chloro-2-naphthylamine has shown that these substances cannot be formulated on the type $CH_2{:}NR$, as indicated in the preliminary note (*Proc.*, 1899, **15**, 10), but have the constitution indicated by the formula $CH_2(NHR)_2$. They do not combine additively with anhydrous hydrogen cyanide, and when treated with phloroglucinol (Tollen's reagent, *Ber.*, 1899, **32**, 2841), they are quantitatively decomposed, yielding 2 mols. of the parent base and 1 equivalent of methylenephloroglucinol, $(C_7H_6O_3)_x$. It follows from these results that the bromo- and chloro-derivatives must be regarded as *methylenedi*-1-*bromo*-2-*naphthylamine*, $CH_2(NH\cdot C_{10}H_6Br)_2$, and *methylenedi*-1-*chloro*-2-*naphthylamine*, $CH_2(NH\cdot C_{10}H_6Cl)_2$ respectively.

85. "The bromination of benzeneazophenol. II." By J. T. Hewitt and W. G. Aston.

When benzeneazophenol is brominated in a glacial acetic acid solution containing an excess of fused sodium acetate, an almost theoretical quantity of benzeneazoorthodibromophenol is obtained. If, however, the sodium acetate be omitted, a tribromo-derivative is formed having a constitution hitherto unknown. The same product is obtained by bromination in aqueous suspension. This substance has now been proved to be *parabromobenzeneazoorthodibromophenol.* The proof has been furnished by brominating parabromobenzeneazophenol in presence of sodium acetate and benzeneazoorthodibromophenol in presence of sulphuric acid. The same substance was obtained in both cases, and is identical with that obtained by the direct action of bromine on benzeneazophenol as described above. The corrected melting point of the substance is 148°, and it has been further characterised by conversion into derivatives.

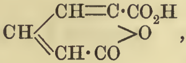
Acetyl ester, m. p. 167°; *benzoyl ester*, m. p. 129°; *ethyl ether*, m. p. 125°.

The isomeric *tribromobenzeneazophenol*, which was prepared from symmetrical tribromaniline for purposes of comparison, and contains the bromine entirely in the benzene nucleus, melts at 168·5°, its *acetyl* derivative at 105°, and its *benzoyl* derivative at 132°.

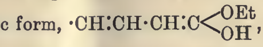
86. "Condensation of ethyl crotonate with ethyl oxalate." By Arthur Lapworth.

A consideration of the points alluded to in a recent note (*Proc.*, 1900, **16**, 108), made it appear probable that ethyl crotonate and allied compounds would react in presence of sodium ethoxide with esters such as ethyl oxalate, and that substitution would occur, not in the α-position as usual, but in the γ-position, corresponding with the *meta*-position in benzoic acid, and to the position occupied by the hydrogen atoms in the methyl group of *o*- and *p*-nitrotoluene. This has been found to be the case.

Ethyl γ-oxalocrotonate, $\mathrm{EtO_2C{\cdot}CO{\cdot}CH_2{\cdot}CH{:}CH{\cdot}CO_2Et}$, is easily prepared from ethyl crotonate and ethyl oxalate by the use of alcohol-free sodium ethoxide. It acts as a fairly strong acid, expelling carbon dioxide from carbonates, and yielding strongly coloured metallic derivatives. Its alcoholic solution is coloured brownish-black by ferric chloride, so that it exists, to some extent at least, in its "enolic" form. It forms nearly colourless crystals melting at 78—80°.

When ethyl γ-oxalocrotonate is hydrolysed by boiling with alkalis it does not give oxalic acid; with hydrochloric acid, *α-pyrone-α′-carboxylic acid*,  $\mathrm{CH}\begin{cases}\mathrm{CH{=}C{\cdot}CO_2H} \\ \mathrm{CH{\cdot}CO} \end{cases}\!\!>\mathrm{O}$, is obtained. This separates from hydrochloric acid in colourless crystals melting at 227—228°.

The formation of ethyl γ-oxalocrotonate in the above manner recalls the observations of Henrich on ethyl glutaconate (*Ber.*, 1898, **31**, 2103), but in the present case the $-\mathrm{CH_2}$-group is not united to two unsaturated groups.

There are many facts bearing on "the negative nature of unsaturated groupings" which seem to point to the insufficiency of the view that the hydrogen atom in the grouping $\mathrm{{:}CH{\cdot}A{:}B}$ or $\mathrm{CH}{<}^{\mathrm{A{:}B}}_{\mathrm{C{:}D}}$ is of itself immediately replaceable, and it appears more likely that the position of attack is usually at a double linkage (compare Henrich, *Ber.*, 1900, **33**, 1437). In the above case, as in many similar ones, it appears not improbable that an intermediate compound derived from a tautomeric form,  $\cdot\mathrm{CH{:}CH{\cdot}CH{:}C}{<}\genfrac{}{}{0pt}{}{\mathrm{OEt}}{\mathrm{OH}}$, is produced, and that subsequently either by addition or isomeric change or by both the γ-carbon atom becomes united with the substituting group (*Trans.* 1898, **73**, 446).

The author proposes to extend the above observations and to examine the capability of other $\alpha\beta$-unsaturated esters of taking part in this and similar condensations.

87. "Researches in silicon compounds. VI. On silicodiphenyldiimide and silicotriphenylguanidine." By J. Emerson Reynolds, Sc.D., M.D., F.R.S.

The author has already described (*Trans.*, 1889, **55**, 474) the well defined crystalline silicophenylamide, $Si(NHC_6H_5)_4$, the first of a new class of compounds in which silicon is exclusively united to nitrogen. It was there stated that when this compound was heated in a vacuum to its melting point (137°) some aniline was given off and a mixture of silicon compounds formed, the constituents of which would be described later. The nature of these products was stated shortly afterwards to the British Association in 1893, but no details were then given. These are now described, before an account of more recent investigations is presented to the Society.

The primary interest attached to the examination of the changes effected by heating silicophenylamide is due to the probable production of silicon analogues of cyanogen compounds.

The study of the action of heat revealed the formation of the *diimide*, $Si(NPh)_2$, which exists in two modifications, one insoluble in benzene and the other soluble, but precipitated by ligroin in droplets which slowly change to the insoluble form. *Silicotriphenylguanidine*, $SiNC_6H_5(NHC_6H_5)_2$, was isolated from the earlier products of the action of heat in small, short rhombic prisms, soluble in benzene. Like all other organic silicon compounds of this kind, it is decomposed by acids, as well as by water and alcohol.

The continued action of heat on the diimide gave rise to a compound represented by the formula $Si_2(NC_6H_5)_3$; this withstood a high temperature without charring, and when heated in dry ammonia left a residue which approximated in composition to $Si_2(NH)_2NC_6H_5$, but the decomposition could not be carried beyond this point without the separation of carbon.

88. "Note on Bach's hydrogen tetroxide." By Henry E. Armstrong.

It is contended by A. Bach (*Ber.*, 1900, **33**, 1506), that the liquid obtained on mixing a solution of hydrogen peroxide with sulphuric acid probably contains hydrogen tetroxide. He bases this conclusion on the observation that when the amount of permanganate which the solution decolorises is contrasted with the amount of oxygen which is evolved, the latter is largely in excess of that which would be obtained if only hydrogen peroxide were present. Bach has obviously failed to take into account the existence of persulphuric acid in such a solution.

In all his experiments—both in those in which palladium hydrogen was oxidised and in those with peroxides—a large excess of normal sulphuric acid was added; the solution was then titrated with permanganate, and the oxygen which was given off was collected and measured. It is noteworthy that the liquid was shaken during several minutes (5—8) after the titration was completed in order to expel the gas. It is open to question whether, in these cases, some persulphuric acid was not formed (Lowry and West, p. 126) by peroxidation of the sulphuric acid, and whether the extra oxygen obtained by Bach was not derived from this.

Bach regards the fact that other dehydrating agents besides sulphuric acid—for example, hydrogen chloride—produce effects, when mixed with hydrogen peroxide, similar to those obtained on using Caro's reagent, as evidence in favour of the view that hydrogen peroxide is converted into tetroxide by dehydration: $3H_2O_2 = H_2O_4 + 2H_2O$. It may be pointed out, however, that the effects produced by Caro's reagent are merely such as it might be anticipated would be exercised by hydrogen peroxide acting in presence of a powerful dehydrating and hydrolysing agent, and it is the use of hydrogen peroxide under such conditions that characterises the novelty in procedure. It is not necessary to assume the existence of any novel specific agent in order to explain them. Caro's original observations stand on a different plane, as they served to establish a difference between the perdisulphates and salts of another acid, and for the first time made it possible to differentiate the acid products of the electrolysis of sulphuric acid.

ADDITIONS TO THE LIBRARY.

I. Donation.

Mendeléeff, D. Recherches expérimentales sur les oscillations de la balance. Translated from the Russian by Mlle. O. Ozarowsky. St. Petersburg 1900. From the Author.

II. By Purchase.

Dugast, J. Vinification dans les pays chauds, Algérie et Tunisie. Paris 1900.

Freind, John. Chymical lectures: in which almost all the operations of chymistry are reduced to their true principles and the laws of nature: read in the Museum at Oxford, 1704. Englished by J. M. 2nd ed. London 1729.

Hjelt, Edvard. Aus Jac. Berzelius' und Gustav Magnus' Briefwechsel in den Jahren, 1828—1847. Herausgegeben von E. H. Braunschweig 1900.

Kunkel, J. Utiles observationes sive animadversiones de salibus fixis et volatilibus, auro et argento potabili, spiritu mundi, et similibus. Item de colore et odore metallorum, mineralium, aliarumque rerum quae a terra producuntur. Trans. from German by C. A. Ramsay. (Dedicated to the Royal Society, with a list of members, 1677). *Also*

Kunkel, J. Observationes chymicae, in quibus agitur de principiis chymicis, salibus acidis et alcalibus, fixis et volatilibus, &c., &c., cum appendice, perspicilli chymici contra non-entia chymica: propria experientia conscriptae. Trans. from German by C. A. Ramsay. London and Rotterdam 1678.

Schmidt, Julius. Uber die Erforschung der Konstitution und die Versuche zur Synthese wichtiger Pflanzenalkaloide. Stuttgart 1900.

Traube, Morris. Gesammelte Abhandlungen. Berlin 1899.

Villiers, A., and Collin, E. Traité des altérations et falsifications des substances alimentaires. Ill. Paris 1900.

Wiesner, Julius. Die Rohstoffe des Pflanzenreiches. 2nd ed. Part 3. Leipzig 1900.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, June 21st, 1900.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

Ashton, James,
Sand Hill House, Hoscar Moss, Ormskirk, Lancs.

Manager of the Wigan Sewage Disposal Works and Farm, Resident Chemist at the works, &c. I am Member of the Institute Sanitary Engineers. Author of "Treatment of the Sewage of Wigan," and other papers on sewage purification. Member Society of Chemical Industry.

W. B. Bottomley. Wm. Jas. Orsman.
Wm. Naylor. *John M. Thomson.*
Patrick H. Kirkaldy.

Battle, George Edward,
"Totlands," Dane Park, Ramsgate.

Assistant Master on the staff of the South Eastern College, Ramsgate. 1. Practical Chemistry course in the Dublin University Laboratories under Professor J. Emerson Reynolds, M.D., D.Sc., F.R.S. 2. B.A. of Trinity College, Dublin, with Honours (Junior Moderator) in Experimental Science. 3. Science Master at the South Eastern College, Ramsgate, during the past three years.

J. Emerson Reynolds. George R. Tweedie.
Emil A. Werner. Francis Jones.
William Briggs.

Brooke, Charles Berjen, jun.,
Colne House, Brantham, near Manningtree, Essex.

Manager of the Brantham Works of the British Xylonite Company, Ld. For some time pupil and assistant to Mr. Edward Riley;

since then and at present time Chemist and Manager to the British Xylonite Co., Ld.

J. N. Goldsmith.	Wyndham R. Dunstan.
Edw. Riley.	*Julian L. Baker.*
John R. Brooke.	*Thomas H. Pope.*

Courtman, Ernest Owen,

Denford House, Atkin's Road, Clapham Park, S.W.

Demonstrator in Assaying in the Metallurgical Division, Royal School of Mines. Associate of the Royal School of Mines in Metallurgy and Mining. Have taught for one year in the Metallurgical and Mining Divisions, Royal School of Mines.

W. C. Roberts Austen.	William A. Tilden.
W. Gowland.	W. Palmer Wynne.

Alfred Stansfield.

Gompertz, Richard Henry Cyril,

110, Elgin Crescent, Notting Hill, W.

Junior Demonstrator in the Chemical Laboratory of the Pharmaceutical Society of Great Britain under Prof. Collie. Student at King's College, London, during the Sessions 1894—1898. Junior and Senior Clothworkers' Scholar, 1894—1897. Appointed Assistant at the Pharmaceutical Society, 1899. B.Sc. London, 1899.

John M. Thomson.	Herbert Jackson.
J. Norman Collie.	Patrick H. Kirkaldy.

Arthur Lapworth.

Gough, John Henry,

22, Francis Street, Chapeltown Road, Leeds.

Teacher of Pharmacy, Victoria University, Leeds. Pharmaceutical Chemist. Teacher of Pharmacy, Medical Department, Yorkshire College (Victoria University), Leeds. Honours Certificate Chemistry, South London School of Pharmacy.

Thomas Fairley.	Harry W. Dixon.
F. W. Branson.	*M. Carteighe.*

B. A. Burrell.

Gritton, Henry Bertie,

"The Cottage," Balmain, Sydney, N.S.W., Australia.

Assayer. Was a Student in Chemistry at Sydney University, and afterwards Junior Demonstrator in Chemistry there, and is at present Assistant Assayer at Sydney Branch of The Royal Mint.

A. Liversidge.	F. B. Guthrie.
J. A. Schofield.	*William M. Hamlet.*
C. Walker.	*John C. H. Mingaye.*

Hinks, Percy John,

16, Moreton Road, South Croydon.

Technical Chemist. Associate of The Royal College of Science (London). Associate of the Institute of Chemistry. Formerly Chemist to the British Non-Flammable Wood Co. At present Assistant to Messrs. Cross and Bevan.

William A. Tilden. G. T. Morgan.
W. Palmer Wynne. C. F. Cross.
M. O. Forster. Edward Bevan.

Ichioka, Tajiro,

8, Nottingham Place, London.

Chemist to Japanese Navy (Kaigun-gishi). Graduated Tokio University (Chemical Department), 1889; became Professor of Chemistry to Naval College (Japanese Navy), 1892; and then, in 1897, became Chief Chemist to Imp. Jap. Arsenal at Kure.

Henry de Mosenthal. Boverton Redwood.
Oscar Guttmann. Edward Divers.
Otto Hehner. *B. E. R. Newlands.*
Arthur R. Ling.

Leathes, John Beresford,

10, Park Mansions, Battersea Park, S.W.

Lecturer on Physiology, St. Thomas's Hospital. "Beiträge zur Chemie der Ovarialmucoide," *Archiv. für Exp. Path. und Pharmakol,* 1899. Papers in *Journal of Physiology,* 1895 and 1896. George Henry Lewes Student, 1897—1899. M.A., M.B., Oxon.

Charles E. Groves. W. D. Halliburton.
Thos. Stevenson. A. Croft Hill.
Wyndham R. Dunstan.

McKenzie, Alexander Ernest,

11, Bank Road, Workington.

Analytical Chemist (Chief) at C. Cammell and Co.'s, Derwent Works, Workington. Teacher of the South Kensington Science and Art Department's Classes in Chemistry at Workington, 1885—1898. Chief Chemist at C. Cammell and Co.'s Derwent Iron and Steel Works, Workington.

Robert Hellon. W. H. Pearson.
Archd. Kitchin. *William Harrington.*
Robt. Carruthers.

McNair, Hugh,

Bellfield, Wishan.

Gas Engineer. Have attended Chemistry Classes in the Glasgow and West of Scotland Technical College, and wish to keep in touch with the progress of Chemistry through the medium of the Journal of the Society.

Thomas Gray. G. G. Henderson.
Matthew A. Parker. *James Robson.*
John Clark.

Napper, Sidney Scrivener,
144, Highbury New Park, N.

Student at Central Technical College since 1896, taking Diploma in Applied Chemisty in 1899. Now engaged in Research under Professor Armstrong.

Henry E. Armstrong. T. M. Lowry.
Gerald T. Moody. Edward W. Lewis.
William A. Davis. Edwin C. Jee.

Patrick, David Herbert,
Earlsdon, Coventry.

Lecturer in Chemistry and Physics, Bablake School of Science, Coventry. Obtained the Prize for Analytical Chemistry at the Birmingham Municipal Technical School, 1892. Late Teacher of Chemistry at the Coventry Municipal Technical Institute. For the last five years Principal Teacher of Chemistry, Physical and Analytical, at the Bablake School of Science.

W. F. Wyley. H. S. Shorthouse.
H. W. Jones. *Chas. Bayliss.*
W. Waters Butler.

Silberrard, Oswald, Ph.D.,
Sunny Croft, Buckhurst Hill, Essex.

Research at the Davy-Faraday Research Laboratory. *Past Experience.*—Certificated Student of Finsbury Technical College. Dr. Phil. University of Würzburg. Worker in Davy-Faraday Laboratory. *Contributions to Chem. Science.*—I. "Über die Polymerisationsproducte aus Diazoessigester," with Prof. Hantzsch (*Ber.*, 33, 58). II. "Synthesis of αα-diglutaric acid," with Prof. Easterfield (University Laboratory, Cambridge), shortly to be published. Work on Tetrazolines in progress.

R. Meldola. Bertram H. Dowles.
Alexander Scott. J. T. Hewitt.
F. Southerden.

Smiddy, Timothy A.,
Kilbarry House, Cork, Ireland.

Soap-manufacturing at Soap Works of W. Smiddy and Son, Cork.

After spending two years at Queen's College, Cork, as Chemical Student, I studied under W. L. Gadd, of Manchester Laboratory, with a view to act as Chemist and Manufacturer in above works, which position I now hold.

Augustus E. Dixon.
Patrick J. D. Fielding.
Robert Elliott Doran.
Daniel J. Mahony.
P. T. O'Sullivan.

Smith, Herbert Procter,
60, Stepney Street, Llanelly.

Metallurgical Chemist. 1893—95 Senior Demonstrator, Leeds School of Science, under the late Mr. S. J. Harris, M.Sc., F.C.S. 1896—97 Pupil Assistant with Mr. Edward Riley, F.I.C., F.C.S., 2, City Road, E.C. 1897—98 Chief Assistant in Laboratory, Ebbw Vale Coal, Iron, and Steel Co., Ltd., under Mr. F. W. Daw, A.R.C.S., F.I.C., F.C.S. 1898—99 Chief Assistant in Laboratory Sir W. G. Armstrong, Whitworth and Co., Manchester. 1899 Chemist and Manager Alloys Syndicate, Ltd., Llanelly.

Edw. Riley.
James E. Ferguson.
F. W. Daw.
Robt. D. Connell.
John Allan.

Tomlins, George Edward,
4, Radford Road, Hither Green, London, S.E.

Analyst. Two years as Student of Chemistry at Royal College of Science. Two years' experience as Assistant Analyst in the Government Laboratory.

T. E. Thorpe.
William A. Tilden.
E. Grant Hooper.
W. Palmer Wynne.
Chapman Jones.

Traquair, John,
Glenfield Starch Works, Paisley, N.B.

Analytical Chemist. Two years a student at City Analyst's Laboratory, Glasgow. Four sessions Evening Classes in Chemistry, Glasgow Technical College. Two years Work's Chemist with F. Henshelwood and Co., Glasgow Oil and Colour Works. Two years Chemist with Wm. Wotherspoon, Glenfield Starch Works, Paisley.

R. R. Tatlock.
James McLeod.
R. T. Thomson.
C. F. Cross.
G. G. Henderson.
John Clark.
James Robson.
Horatio Ballantyne.
Matthew A. Parker.
Edward Bevan.

The following Certificates were authorised by the Council under Bye-law I (3) :—

Cantin, Angélo,
Vacoas, Mauritius.

Acting Professor of Chemistry, Royal College Mauritius. Undergraduate of the University of London. Has been a successful teacher of Chemistry for the last 11 years at the Royal College of Mauritius, where the students read for the English Scholarship Examination, for the Matriculation Examination of the University of London, and for the Junior and Senior Cambridge Locals.

W. T. A. Edwards.

Row, M. C. Nanjunda,
Mylapore, Madras, South India.

First Assistant Chemical Examiner. B.A., M.B., and C.M. of the Madras University. Assistant Examiner in Chemistry to the University of Madras for the years 1897 and 1898. Assistant to the Professor of Hygiene, Madras Medical College, from March, 1892, to July, 1895, and have been First Assistant to the Chemical Examiner to Government of Madras from July, 1895, which appointment I still hold. In the former appointment, I had opportunities of assisting in the conduct of class work in Practical Hygiene, and in the latter, of carrying out chemical analyses of miscellaneous articles of foods and drugs, and of assisting in the analyses of chemico-legal cases.

J. L. van Geyzel. Samuel Jackson.
J. Walter Leather.

Roy, M. Goolab,
Chintadrepettah, Madras.

Second Assistant to the Chemical Examiner. Have been an Assistant in the Laboratory of the Chemical Examiner to the Madras Government for 17 years, during which period I have had opportunities of conducting a large number of analyses of miscellaneous articles, food, drugs, oils, and explosives. Latterly, I have also assisted in chemico-legal analyses.

J. L. van Geyzel. Samuel Jackson.
J. Walter Leather.

At the next meeting, on June 21st, there will be a Ballot for the Election of Fellows, and the following papers will be communicated :—

"Notes on the chemistry of chlorophyll." By Leon Marchlewski, PhD., and C. A. Schunck.

"Researches on morphine. I." By S. B. Schryver and F. H. Lees.

"A new series of pentamethylene derivatives. I." By W. H. Perkin, jun., J. F. Thorpe, and C. W. Walker.

"Experiments on the synthesis of camphoric acid. III. The action of sodium and methyl iodide on ethyl dimethylbutanetricarboxylate." By W. H. Perkin, jun., and J. F. Thorpe.

"On the oxime of mesoxamide and some allied compounds." By (Miss) M. A. Whiteley, B.Sc.

"The oxyphenoxy- and phenyleneoxy-acetic acids." By W. Carter and Dr. W. T. Lawrence, B.A., Ph.D.

"The condensation of ethyl α-bromo-isobutyrate with ethyl malonates and ethyl cyanacetates: α-methyl-α′-isobutylglutaric acid." By Dr. W. T. Lawrence, B.A., Ph.D.

"Methylisoamylsuccinic acid. II." By Dr. W. T. Lawrence, B.A., Ph.D.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 226.

June 21st, 1900. Professor THORPE, C.B., F.R.S., President, in the Chair.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected :—Messrs. James Ashton ; George E. Battle, B.A. ; Charles Berjen Brooke, jun. ; Angélo Cantin ; Ernest Owen Courtman ; Richard H. C. Gompertz, B.Sc. ; John Henry Gough ; Henry Bertie Gritton ; Percy John Hinks ; Tajiro Ichioka ; John B. Leathes, M.A., M.B. ; Alexander Ernest McKenzie ; Hugh McNair ; Sidney Scrivener Napper ; David Herbert Patrick ; M. C. Nanjunda Row, B.A., M.B. ; M. Goolab Roy ; Oswald Silberrad, Ph.D. ; Timothy A. Smiddy ; Herbert Procter Smith ; George Edward Tomlins ; John Traquair.

Of the following papers, those marked * were read :—

*89. "Researches on morphine. I." By S. B. Schryver and F. H. Lees.

The authors have found that the alcoholic hydroxyl group in morphine is readily replaceable, and they have prepared the compounds described below.

Chloromorphide, $C_{17}H_{18}O_2NCl$, prepared by the action of phosphorus trichloride on dry morphine. It melts at 190° with decomposition, and dissolves readily in chloroform and in methyl alcohol. The *hydrochloride*, $C_{17}H_{18}O_2NCl,HCl$, and *hydrobromide*, $C_{17}H_{18}O_2NCl,HBr$, have also been prepared. On treatment with acetic anhydride, the *monoacetyl* derivative, $C_{17}H_{17}O(OC_2H_3O)NCl$, is obtained melting at 178—179°.

Bromomorphide, $C_{17}H_{18}O_2NBr$, melting with decomposition at 170°, has a very bitter taste and dissolves readily in chloroform and benzene. Its *hydrochloride* and *hydrobromide* crystallise with one molecule of water. Bromomorphide can also be prepared by the action of concentrated hydrobromic acid on morphine.

By treating chloromorphide with tin and hydrochloric acid, *desoxymorphine hydrochloride,* $2(C_{17}H_{19}O_2NHCl),3H_2O$, is obtained as glistening needles. The salt is lævorotatory ; $[\alpha]_D^{27} = -140{\cdot}3°$.

It was found that on heating chloro- and bromo-morphide and their hydrochlorides with water, decomposition took place, bromomorphide giving the hydrobromide of a base isomeric with morphine ; for this new base the authors propose the name *isomorphine.* Isomorphine and its derivatives are more powerfully lævorotatory than morphine and its corresponding derivatives. The salts of isomorphine are much more readily soluble than those of morphine. Isomorphine melts at 246—247°, is readily soluble in methyl alcohol, but only very sparingly so in ether, chloroform, or benzene. Recrystallised from hot water, it is obtained as glistening needles. In methyl alcohol, $[\alpha]_D^{25} = -164{\cdot}3°$. For the *hydrochloride,* $C_{17}H_{19}O_3N,HCl$, $[\alpha]_{D.}^{25°} = -150°$; for the *hydrobromide,* $C_{17}H_{19}O_3N,HBr,H_2O$, $[\alpha]_D^{20} = -127{\cdot}2°$ for the anhydrous salt. The *methiodide,* $C_{17}H_{19}O_3N,CH_3I$, melts with vigorous decomposition at 279°; in aqueous solution, $[\alpha]_D^{25} = -91{\cdot}5°$. Morphine methiodide also melts at 279°, but for it $[\alpha]_D = -72{\cdot}9°$.

By treatment of isomorphine methiodide in aqueous solution with silver sulphate and barium hydroxide, a very alkaline solution of the hydroxide is obtained, which, dried in a vacuum, sets first to a deliquescent mass of fern-like crystals, and on further dehydration in a vacuum yields a solid which can readily be powdered. This substance dissolved in methyl alcohol does not react in the cold with methyl iodide, but does so readily on warming, giving a methiodide extremely soluble in water and in methyl alcohol, but only slightly so in ethyl alcohol. For it $[\alpha]_D^{25} = -96{\cdot}4°$. This compound is not identical with codeine methiodide.

The determinations recorded in the following table were made with the free bases dissolved in methyl alcohol, and the salts (anhydrous) in water :

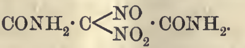
	Free base.	Hydrochloride.	Hydrobromide.
Morphine	$[\alpha]_D^{23} = -130{\cdot}9°$	$[\alpha]_D^{26} = -111{\cdot}5°$	$[\alpha]_D^{20} = -100{\cdot}4$
Chloromorphide	$[\alpha]_D^{27} = -375{\cdot}2$	$[\alpha]_D^{21} = -313{\cdot}7$	$[\alpha]_D^{19} = -268{\cdot}6$
Bromomorphide	$[\alpha]_D^{25} = +65{\cdot}6$	$[\alpha]_D^{27} = +41{\cdot}1$	$[\alpha]_D^{25} = +39{\cdot}5$

Chloromorphide, bromomorphide, desoxymorphine and isomorphine are all devoid of narcotic action. The significance of these facts and the relationship between morphine and isomorphine were also discussed.

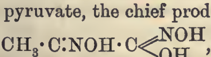
*90. "On the oxime of mesoxamide and some allied compounds." By Martha Annie Whiteley, B.Sc.

The compound formed by the action of nitrosyl chloride on malonamide (Tilden and Forster, *Trans.*, 1895, 67, 490) appears to be the isonitroso-derivative, $NH_2OC{\cdot}C(NOH){\cdot}CONH_2$. It dissolves readily in water, has an acid reaction, and melts with decomposition at 187°. It forms alkaline salts which are bright yellow in colour and are easily soluble in water. Its most characteristic reaction is the production of an intense purple coloration when neutralised with an alkali and a solution of ferrous sulphate added. This is due to the formation of a double potassium ferrous salt, $KFe(C_3H_4N_3O_3)_3$, which crystallises from concentrated solutions in minute prisms having the lustre of bronze. The acetyl derivative of the oxime resembles the original substance in appearance, and melts with decomposition at 190°. The ethyl ether is crystalline, and melts at 150—151°.

The oxime can be prepared by the action of nitrous acid on the aqueous solution of malonamide, and by the action of hydroxylamine on dibromomalonamide.

By the action of nitrous acid on the oxime, a crystalline, sparingly soluble compound is obtained, which melts with decomposition at about 215°. It contains the proportion of nitrogen corresponding to a pseudonitrol of the formula  $CONH_2{\cdot}C{<}^{NO}_{NO_2}{\cdot}CONH_2$. It does not respond to Liebermann's test, nor does it react as an oxime. By the continued action of nitrous acid, oxalic acid was the only solid product obtained.

The oxime is reduced by hydriodic acid to aminomalonamide, $CONH_2{\cdot}CHNH_2{\cdot}CONH_2$, the hydriodide of which crystallises in prisms.

The oxime of pyruvamide, $CH_3{\cdot}C(NOH){\cdot}CONH_2$, prepared by the action of ammonia on the oxime of ethyl pyruvate, melts at 176—177° and closely resembles the oxime of mesoxamide, but the alkaline solutions exhibit no decided yellow colour, whilst the colour produced by the addition of ferrous sulphate to the alkaline solution is reddish-brown. In attempting to prepare the oxime of pyruvamide by the joint action of ammonia and hydroxylamine on ethyl pyruvate, the chief product obtained was the oximidohydroxamic acid,  $CH_3{\cdot}C{:}NOH{\cdot}C{<}^{NOH}_{OH}$, which is readily soluble, melts with decomposition at 143°, and is distinguished, not only by the cherry-red colour which is produced by the addition of ferric chloride, but by the production of an intense reddish-brown liquid and subsequent precipitate on the addition of ferrous sulphate to the alkaline solution.

Succinamide submitted to the action of nitrosyl chloride or of nitrous acid is attacked but slowly, yielding succinic acid, but no oxime or other derivative.

Attempts to prepare Piutti's β-oxime of the half acid ethylsuccinic ester were not successful; this was apparently due to the spontaneous conversion of the β-compound into Ebert's α-isomeride. Cramer (*Ber.*, 1891, **24**, 1204) represents the β-compound as the stable, and the α- as the labile isomeride.

*91. "On dimethyldiacetylacetone, tetramethylpyrone, and orcinol derivatives from diacetylacetone." By J. N. Collie, F.R.S., and B. D. Steele, M.Sc.

That dimethylpyrone is capable of acting as a basic substance, forming salts with acids has already been clearly shown (Collie, *Trans.*, 1899, **75**, 710). This work has been continued and the basic properties of tetramethylpyrone have been investigated.

The sodium salt of dimethylpyrone reacts with methyl iodide, giving *dimethyldiacetylacetone*, m. p. 87°, $C_7H_8O_3Na_2 + 2CH_3I = C_7H_8O_3(CH_3)_2 + 2NaI$. When warmed with hydrochloric acid this compound loses water and is converted into *tetramethylpyrone*, $C_7H_8O_3(CH_3)_2 = C_7H_6O_2(CH_3)_2 + H_2O$. Tetramethylpyrone melts at 92°. It crystallises from water as a monohydrate, m. p. 63—64°. It forms a hydrochloride and a platinichloride, but appears to be less basic than dimethylpyrone. From the residues after separation of the dimethyldiacetylacetone, two other substances have been isolated, (1) trimethylpyrone, $C_8H_{10}O_2$, m. p. 78°, which forms a platinichloride; and (2) a derivative of orcinol, $C_9H_{12}O_2$, m. p. 150°, possibly trimethyl-1 : 2 : 4-dihydroxy-3 : 5-benzene.

This orcinol derivative resembles mesorcinol in a very remarkable manner, but it is difficult to see how mesorcinol, which is 1 : 3 : 5-trimethyl-2 : 4-dihydroxybenzene, could be produced from dimethyldiacetylacetone.

A second orcinol derivative, $C_9H_{12}O_2$, was obtained by treating the crude product of the action of methyl iodide on disodiumdiacetylacetone with hydrochloric acid. It melts at 105° and in all its reactions resembles the compound melting at 150°.

Dimethylpyrone unites with sodium ethoxide to form a compound, $C_7H_8O_2NaOEt$, which on treatment with acids yields *ethyldiacetylacetone*, $C_7H_9O_3Et$. This latter substance is very unstable, and easily decomposes into alcohol and dimethylpyrone when heated with acids.

*92. "Dehydracetic acid." By J. N. Collie, F.R.S.

Since the publication of a paper on dehydracetic acid (Collie and Le Sueur, *Trans.*, 1894, **65**, 254), several reactions and the properties of various compounds of the acid have been investigated, all of which agree with the formula put forward by the author some years ago, namely, that dehydracetic acid is the lactone of tetracetic acid. The production of dehydracetic acid from triacetic lactone has been accomplished, as indicated by the following equation,

$$C_6H_6O_3 + (CH_3CO)_2O = C_8H_8O_4 + CH_3CO_2H.$$

Although neither acetyl chloride nor acetic anhydride react with triacetic lactone alone, if the lactone be boiled with acetic anhydride and a little sulphuric acid or sodium acetate, dehydracetic acid is formed. The action of ammonia on the isomeric acid $C_8H_8O_4$ (obtained by Feist from the dichloride of dehydracetic acid) has been investigated,and an acid, $C_6H_9NO_3$, has been obtained identical with that previously isolated from the products of the action of heat on ethyl β-amidocrotonate.

The production of dehydracetic acid from several of its dried salts has been studied. The dried sodium and silver salts treated with hydrogen chloride, and the dried lead salt with hydrogen sulphide, give dehydracetic acid.

The conductivity of a very pure sample of dehydracetic acid has been determined by Prof. J. Walker, who finds it to be 0·0001.

*93. "The decomposition of hydroxyamidosulphates by copper sulphate." By E. Divers and T. Haga.

When a hydroxyamidosulphate is heated in solution with copper sulphate it is entirely decomposed. This takes place in such a manner as to throw much light on the nature of the obscure decompositions of these salts, as well as of the hydroximidosulphates and hydroxylamine salts when impure. No change is observed in the copper sulphate during the change it brings about, but of its alternate reduction and oxidation evidence is given, if, instead of the sulphate, cupric chloride be employed, as this is reduced to cuprous chloride.

The principal change caused by the copper sulphate may be represented by the equation $2Cu(H_2NSO_4)_2 = Cu(H_2NSO_3)_2 + Cu(H_2NSO_5)_2$, the latter salt being represented by the actual products $Cu(H_2NSO_5)_2 = N_2O + H_2O + H_2SO_4 + CuSO_4$. Another change always takes place at the same time, being less marked when the temperature is low, and more so when the temperature is high. For example, a hydroximidosulphate resists the action of the copper sulphate until the temperature of the solution is over 100°, when it hydrolyses to hydroxyamidosulphate, 28 per cent. of which decomposes so that all its sulphur becomes dioxide, its hydrogen water, and its nitrogen nitrous oxide. If one-third of the hydroxyamidosulphate decomposed thus, the reaction would be expressed by the equation, $3Cu(H_2NSO_4)_2 = 2N_2O + 4H_2O + 2SO_2 + 2CuSO_4 + Cu(H_2NSO_3)_2$. Hydroxyamidosulphate decomposing under the influence of copper sulphate may give as little as 3½ per cent. of its sulphur as dioxide. In all cases, the quantity of sulphur appearing as sulphate approximately equals that as amidosulphate. The production of any free nitrogen is still doubtful; it could only be formed when the sulphur as sulphate exceeded in amount that existing as amidosulphate.

*94. "The degradation of glycollic aldehyde." By H. J. H. Fenton.

As glycollic aldehyde is now obtainable in a pure state (*Trans.*, 1895, **67**, 774), experiments are being carried on with a view of studying its relationships and properties. The author showed that by means of Wohl's reaction formaldehyde may readily be obtained from glycollic aldehyde. Glycollic aldoxime is obtained as a syrup from the interaction of the aldehyde and hydroxylamine in alcoholic solution, but it has not been obtained quite pure. When this syrup is mixed with acetic anhydride and sodium acetate, a violent reaction takes place, and the acetyl derivative of glycollic nitrile (b. p. 177°) is formed. This is identical with that obtained by Henry (*Compt. rend.*, 1890, **110**, 759—760) from formaldehyde and hydrogen cyanide. When this acetyl derivative is acted upon by the calculated quantity of ammoniacal solution of silver oxide, silver cyanide separates in a crystalline state, and a product is obtained which, with dilute sulphuric acid, yields abundance of formaldehyde.

95. "Notes on the chemistry of chlorophyll." By Leon Marchlewski, Ph.D., and C. A. Schunck.

The authors first discussed the absorption spectrum of unaltered chlorophyll, and conclude (1) that this spectrum is characterised by three bands between the lines B and F and three between F and K_β; (2) that the bands exhibited by crude leaf extracts are caused by one chemical compound, chlorophyll, and not by several substances; (3) that no solution which does not exhibit this spectrum can be said to contain chlorophyll, no matter how it may have been prepared. Unaltered chlorophyll, by the action of hydrochloric acid, ought to give both phylloxanthin and phyllocyanin, the latter most certainly. The authors contend that Hartley's "blue chlorophyll" is not unaltered chlorophyll, but a derivative closely allied to alkachlorophyll, since its spectrum is quite different from that of unaltered chlorophyll and gives with acids phyllotannin or its derivatives, but neither phylloxanthin nor phyllocyanin.

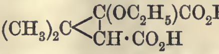
As to the several "chlorophylls," the authors corroborated the results of Hartley and Sorby's experiments, which tend to show the existence of a colouring matter besides chlorophyll proper and the members of the xanthophyll group. They show, however, that Hartley's "yellow chlorophyll" is a mixture of this additional colouring matter with members of the xanthophyll group, and that by removing the latter its colour is green; the name "yellow chlorophyll" is therefore unsuitable. Crude leaf extracts therefore contain two green colouring matters, chlorophyll proper and another which is present only in *small* quantity; this exhibits a red fluorescence and is characterised by an absorption band in the red which is more refrangible than that of true chlorophyll. The authors described a method by which chlorophyll could be obtained almost free from this green colouring matter, and from the members of the xanthophyll group.

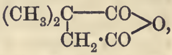
The action of bromine on phylloporphyrin and hæmatoporphyrin is very similar, and this is considered by the authors as an additional proof of the close relationship of these substances.

96. "A new series of pentamethylene derivatives. I." By W. H. Perkin, jun., Jocelyn F. Thorpe, and C. Walker.

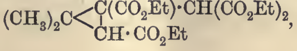
When ethyl *aa′*-dibrom-*ββ*-dimethylglutarate,

$$CO_2Et\cdot CHBr\cdot C(CH_3)_2\cdot CHBr\cdot CO_2Et,$$

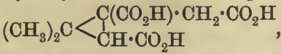
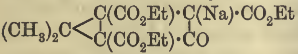
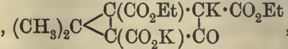
is treated with an alcoholic solution of potash, it is converted quantitatively into *ethoxycaronic acid*,  $(CH_3)_2C<\begin{array}{l}C(OC_2H_5)CO_2H\\ |\\ CH\cdot CO_2H\end{array}$, which separates from benzene in long needles melting at 136°; the *anhydride*, made by distilling the acid, boils at 160—165° (50 mm.), and on boiling with water is reconverted into the acid.

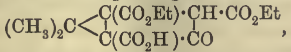
When warmed with concentrated sulphuric acid, or when heated with hydrobromic acid in a sealed tube, the acid is converted into the anhydride of *asym*-dimethylsuccinic acid,  $\begin{array}{l}(CH_3)_2C\text{——}CO\\ \quad\quad\;\;|\\ \quad\quad CH_2\cdot CO\end{array}>O$, which melts at 39°, and on boiling with water yields *asym*-dimethylsuccinic acid melting at 139°.

When ethyl dibromdimethylglutarate is condensed in alcohol solution with an equimolecular proportion of ethyl sodiomalonate, a 60 per cent. yield of an ester of the probable formula

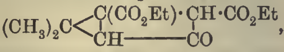
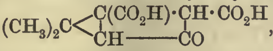


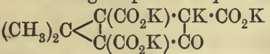
$$(CH_3)_2C<\begin{array}{l}C(CO_2Et)\cdot CH(CO_2Et)_2\\ |\\ CH\cdot CO_2Et\end{array},$$

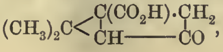
is produced; it is a thick liquid which boils at 234° (20 mm.), and on hydrolysis with alcoholic potash is converted into the *tribasic* acid,  $(CH_3)_2C{<}\begin{array}{l}C(CO_2H)\cdot CH_2\cdot CO_2H\\ CH\cdot CO_2H\end{array}$, a colourless substance which separates from water in small needles and melts at 176° with evolution of aqueous vapour. When ethyl dibromdimethylglutarate is condensed with 2 equivalents of ethyl sodiomalonate in the presence of excess of sodium ethoxide, a yellow *sodium* compound of the formula  $(CH_3)_2C{<}\begin{array}{l}C(CO_2Et)\cdot C(Na)\cdot CO_2Et\\ C(CO_2Et)\cdot CO\end{array}$ is produced to the extent of 60 per cent. of the theoretical amount; it is a remarkably stable substance, giving in alcoholic solution a deep red coloration with ferric chloride, and on hydrolysis in the cold with methyl alcoholic potash is converted into the yellow *potassium* compound,  $(CH_3)_2C{<}\begin{array}{l}C(CO_2Et)\cdot CK\cdot CO_2Et\\ C(CO_2K)\cdot CO\end{array}$, this when acidified, gives the corresponding *acid ester*,

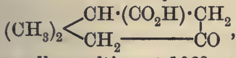

$$(CH_3)_2C{<}\begin{array}{l}C(CO_2Et)\cdot CH\cdot CO_2Et\\ C(CO_2H)\cdot CO\end{array},$$

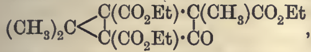
which crystallises from dilute alcohol in large prisms and melts at 75°.

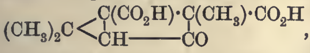
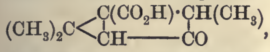
On distilling this acid ester under diminished pressure, carbon dioxide is eliminated, and the *ester*,  $(CH_3)_2C{<}\begin{array}{l}C(CO_2Et)\cdot CH\cdot CO_2Et\\ CH\text{———}CO\end{array}$, passes over at 201° (30 mm.) as a thick oil which gives an intense violet colour with ferric chloride, and on hydrolysis with potash is converted into the *acid*  $(CH_3)_2C{<}\begin{array}{l}C(CO_2H)\cdot CH\cdot CO_2H\\ CH\text{———}CO\end{array}$, a colourless substance crystallising from concentrated hydrochloric acid in large prisms and melting at 179°; it gives a red coloration with ferric chloride.

When the sodium compound mentioned above is treated with an equal weight of potash dissolved in ethyl alcohol, it passes into solution, and on boiling deposits a *potassium* salt, of the probable constitution,  $(CH_3)_2C{<}\begin{array}{l}C(CO_2K)\cdot CK\cdot CO_2K\\ C(CO_2K)\cdot CO\end{array}$; this, on being acidified, yields a mixture of two isomeric acids, which can be separated by recrystallisation from dilute hydrochloric acid. The more soluble acid is identical with the acid mentioned above melting at 179°, the *less soluble acid* crystallises from dilute hydrochloric acid in needles melting at 154—155° with evolution of carbon dioxide; it gives an intense violet colour with ferric chloride; the first acid is called the α-, the second the β-modification.

Both modifications, the β- on heating above its melting point, the α- on heating with water in a sealed tube at 200°, are quantitatively converted into the *acid*,  $(CH_3)_2C{<}\begin{array}{l}C(CO_2H).CH_2\\ CH\text{———}CO\end{array}$, which crystallises from water in fern-like needles melting at 180° and subliming when heated, in long, silky needles; the *semicarbazone* melts and decomposes at 225°, and the *hydrazone* at 217°.

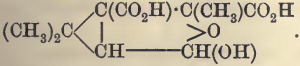
On reducing the ketonic acid melting at 180° with sodium amalgam it behaves in a remarkable manner, the ketone group remaining intact and the trimethylene linkage being reduced, forming the *acid*,  $(CH_3)_2<\begin{array}{l}CH\cdot(CO_2H)\cdot CH_2\\ CH_2\text{————}CO\end{array}$, which separates from water in microscopic needles melting at 103°; the *semicarbazone* decomposes at 215°.

When the yellow sodium compound mentioned above is treated in alcoholic solution with methyl iodide it is converted into the *ester*  $(CH_3)_2C<\begin{array}{l}C(CO_2Et)\cdot C(CH_3)CO_2Et\\ C(CO_2Et)\cdot CO\end{array}$, a colourless oil boiling at 219° (20 mm.) and giving no coloration with ferric chloride.

On hydrolysis with methyl alcoholic potash, this ester is converted into a potassium salt which when acidified gives the *acid*  $(CH_3)_2C<\begin{array}{l}C(CO_2H)\cdot C(CH_3)\cdot CO_2H\\ CH\text{———}CO\end{array}$, a colourless substance crystallising from benzene in lustrous plates melting at 146°, this, when heated in aqueous solution at 200°, gives the *acid*,  $(CH_3)_2C<\begin{array}{l}C(CO_2H)\cdot CH(CH_3)\\ CH\text{———}CO\end{array}$, which separates from water in glistening plates and melts at 134°; the *semicarbazone* decomposes at 230°.

If the potassium salt just mentioned be not separated, but the heating continued, it passes into solution with the formation of *an acid* characterised by being practically insoluble in dry ether, and which differs from the acid melting at 146° in containing 1 mol. of water of constitution. It separates slowly from water in large prisms melting at 237°, and when distilled under ordinary pressure passes over at about 270° as an oil which solidifies on cooling. This on boiling with water is converted into an *isomeric acid* which separates from water in needles melting at 180—181°, with formation of the anhydride.

The reactions of these compounds seem to indicate that they are stereoisomeric furfurane derivatives having the formula

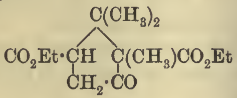


$$(CH_3)_2C<\begin{array}{l}C(CO_2H)\cdot C(CH_3)CO_2H\\ |\qquad\qquad\quad >O\\ CH\text{———}CH(OH)\end{array}.$$

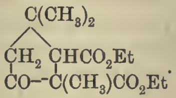
The investigation of these compounds, which are closely allied to several derivatives of the camphor and terpene series, is in progress, and experiments are being carried out in order to study the behaviour of other glutaric acids under the conditions indicated above.

97. "Experiments on the synthesis of camphoric acid. III. The action of sodium and methyl iodide on ethyl dimethylbutanetricarboxylate." By W. H. Perkin, jun., and Jocelyn Field Thorpe.

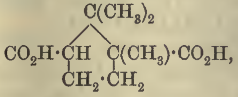
When ethyl dimethylbutanetricarboxylate (*Trans.*, 1899, 75, 900), dissolved in toluene, is treated with sodium and then with methyl iodide, a considerable yield of an ester is obtained which boils at 168—170° (18 mm.), and on analysis gives numbers agreeing with the formula $C_{14}H_{22}O_5$. The method of formation of this substance clearly indicates that it must have one of the two following constitutional formulæ:



I.



II.

If the ester has the constitution represented by formula I, it must be closely allied to, and will probably be easily converted into, an acid having the constitutional formula  assigned by Bredt to camphoric acid.

On reduction by means of sodium amalgam, this ester is converted quantitatively into a syrupy hydroxy-acid, which on long standing shows signs of crystallising. The analysis of this acid and its silver salt shows that it has the formula $C_{10}H_{16}O_5$; it is therefore isomeric with camphanic acid. The authors are continuing the investigation of these substances.

98. "The oxyphenoxy- and phenylenoxy-acetic acids." By W. Carter and W. Trevor Lawrence.

The phenylenoxyacetic acids, $C_6H_4(OCH_2CO_2H)_2$, are obtained according to either of the following equations:

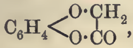
1. $C_6H_4(ONa)_2 + 2CH_2BrCO_2Et = C_6H_4(OCH_2CO_2Et)_2 + 2NaBr.$
2. $C_6H_4(ONa)_2 + 2CH_2ClCO_2Na = C_6H_4(OCH_2CO_2Na)_2 + 2NaCl.$

The condensation according to the first equation is not complete in the cases of resorcinol and hydroquinol, and a certain amount of acid ester, $C_6H_4(OH)(OCH_2CO_2Et)$, corresponding to the oxyphenoxyacetic acids is formed, and may be separated from the neutral ester by potash solution.

On pouring the esters into alcoholic potash the potassium salts of the acids are precipitated as microcrystalline powders, which when acidified yield the free acids.

The amides are obtained from the esters by shaking with aqueous ammonia, the aniline salts result on boiling the acids with a benzene solution of aniline, and the anilides are obtained by heating the acids to 190° with aniline.

Pyrocatechol derivatives.

Ethyl pyrocatecholdiacetate, $C_6H_4(OCH_2CO_2Et)_2$, boils at 230—232° (30 mm.). *Pyrocatecholdiacetic acid*, $C_6H_4(OCH_2CO_2H)_2$, needles from water, m. p. 178°. *Aniline salt*, m. p. 250°. *Barium salt*, $2(C_{10}H_8O_6Ba),H_2O$. *Pyrocatecholdiacetanilide*, $C_6H_4(OCH_2CONHPh)_2$, m.p. 196°. *Pyrocatecholdiacetamide*, $C_6H_4(OCH_2CONH_2)_2$, m. p. 203°. *Ethyl pyrocatecholmonoacetate*, $C_6H_4(OH)(OCH_2CO_2Et)$, b. p. 155° (30 mm.). *Pyrocatecholmonoacetic acid*, $C_6H_4(OH)(OCH_2CO_2H)$, prisms from water, m. p. 152°. *Anhydropyrocatecholmonoacetic acid*,  $C_6H_4<\begin{matrix}O\cdot CH_2\\ O\cdot CO\end{matrix}$, prisms from ligroin, m. p. 57°. *Pyrocatecholmonoacetanilide*, $C_6H_4(OH)(OCH_2CONHPh)$, m. p. 161°. [Compare Moureu, *Bull.*, 1899, [iii], **21**, 107].

Resorcinol derivatives.

Ethyl resorcindiacetate, $C_6H_4(OCH_2CO_2Et)_2$, m. p. 42° (B. 40°), b. p. 228° (32 mm.). *Resorcindiacetic acid*, $C_6H_4(OCH_2CO_2H)_2$, m. p. 195°. The silver, copper, and iron salts are amorphous, the calcium and barium salts crystalline. *Aniline salt*, m. p. 137°. *Resorcindiacetanilide*, $C_6H_4(OCH_2CONHPh)_2$, m. p. 169° (B. ca. 182°). *Imidoester*, $[C_6H_4(OCH_2CO_2Et)OCH_2CO]_2NH$, m. p. 43°. *Resorcindiacetamide*, $C_6H_4(OCH_2CONH_2)_2$, m. p. 167°. 2 : 4 : 6-*Trinitroresorcindiacetic acid*, $C_6H(NO_2)_3(OCH_2CO_2H)_2$, is formed by boiling resorcindiacetic acid with nitric acid, m. p. 174°, converted by potash at 140° into styphnic acid. *Resorcinmonoacetic acid*, $3(C_8H_8O_4),H_2O$, m. p. 158°, anhydrous needles from toluene, m. p. 160° (B. 158°). *Resorcinmonoacetanilide*, m. p. 125°.

Hydroquinol derivatives.

Ethyl hydroquinoldiacetate, $C_6H_4(OCH_2CO_2Et)_2$, needles from ligroin, m. p. 72°. *Hydroquinoldiacetic acid*, $C_6H_4(OCH_2CO_2H)_2$, prisms insoluble in all solvents tried except acetic acid, m. p. 251° (B. ca. 246°). *Hydroquinoldiacetanilide*, $C_6H_4(OCH_2CONHPh)_2$, m. p. 210°. The ammonium salt crystallises in needles from water, the silver and copper salts are amorphous, and the calcium and barium salts crystalline.

Hydroquinolmonoacetic acid, $3(C_8H_8O_4),H_2O$, prisms from water, anhydrous needles from toluene, m. p. 152°. *Aniline salt*, m. p. 119°. *Hydroquinolmonoacetanilide*, $C_6H_4(OH)(OCH_2CONHPh)$, m. p. 101°.

The melting points in brackets, and indicated by B, refer to a private communication from Prof. C. A. Bischoff, who is engaged in the investigation of many of these substances, in pursuance of his "Studies on Condensations," and to whom we therefore relinquish their further study.

99. "The condensation of ethyl α-bromoisobutyrate with ethyl malonates and ethyl cyanacetates: α-methyl α′-isobutylglutaric acid." By W. Trevor Lawrence, B.A., Ph.D.

The author showed that the following general reactions hold good:

I. $CNaRX(CO_2Et) + CBr(CH_3)_2CO_2Et = CRX(CO_2Et){\cdot}C(CH_3)_2(CO_2Et) + NaBr$, when the sodium compound is in suspension,

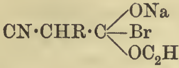
II. $CNaRX(CO_2Et) + CBr(CH_3)_2(CO_2Et) = CRX(CO_2Et){\cdot}CH_2{\cdot}CH(CH_3)(CO_2Et) + NaBr$,

when the sodium compound is in solution,

where $R = H$ or an alkyl group; $X = (CN)$ or (CO_2Et).

The behaviour of ethyl bromoisobutyrate is probably influenced by the degree of ionisation of the sodium compound.

The author suggests that the hydrobromic acid liberated from the bromoisobutyric ester combines with (the enolic form of) ethyl sodiomalonate or -cyanacetate to form a hypothetical addition compound, for example,



$CN{\cdot}CHR{\cdot}C\begin{cases}ONa\\Br\\OC_2H_5\end{cases}$

, which condenses with the unsaturated ester with separation of sodium bromide.

The following substances were isolated and investigated in the course of this research:—

I. In the condensation of ethyl sodioisobutylmalonate with ethyl α-bromoisobutyrate, or ethyl α-methacrylate in alcoholic solution.

Ethyl α-methyl-α′-isobutylpropanetricarboxylate,

$$CH(CH_3)CO_2Et{\cdot}CH_2{\cdot}C(C_4H_9)(CO_2Et)_2,$$

b. p. 185° (18 mm.), converted by hydrolysis with alcoholic potash into the potassium salt of *α-methyl-α′-isobutylpropanetricarboxylic acid.* This acid melts at 167—168° (with evolution of carbon dioxide and formation of cis- and trans-*methylisobutylglutaric acids*).

The *cis*- and *trans*-methylisobutylglutaric acids,

$$CH(CH_3)(CO_2H){\cdot}CH_2{\cdot}CH(C_4H_9)CO_2H,$$

are best separated by crystallisation from boiling ligroin (b. p. 110—120°).

cis-*Acid,* m. p., 121°. *Anhydride,* a liquid, b. p. 196° (50 mm.). *Anilic acid,* $C_{16}H_{23}O_3N$, m. p. 164°.

trans-*Acid,* m. p. 86—87°. *Anhydride,* a liquid, b. p. 178° (22 mm.). *Anilic acid,* m. p. 196°.

The *trans*-acid may be converted into the *cis*-modification by heating with hydrochloric acid in a sealed tube, or into the *cis*-anhydride by distillation or by heating with acetic anhydride to 220°.

II. In the condensation of ethyl sodioisobutylcyanacetate, b. p. 165° (50 mm.), with ethyl bromoisobutyrate or ethyl α-methacrylate in alcoholic solution: in the condensation of ethyl sodiocyanacetate with ethyl methacrylate and subsequent addition of isobutyl bromide.

Ethyl α-methyl-α'-isobutyl-α'-cyanoglutarate,

$$CH(CH_3)CO_2Et\cdot CH_2\cdot C(C_4H_9)(CN)(CO_2Et),$$

b. p. 196° (25 mm.), on hydrolysis with alcoholic potash, is converted into the potassium salt of a substance, $C_{11}H_{17}O_4N$, which melts at 164°, with evolution of carbon dioxide. This substance is possibly a mixture of methylisobutylcyanoglutaric acid with the monocarboxylic acid of methylisobutylglutarimide, as on distillation (295°, 760 mm.) the imide (m. p. 78°) of the *cis*-acid (insoluble in sodium carbonate) and the nitrile of the *trans*-acid are obtained.

It is converted by hydrochloric acid into a mixture of *trans*-glutaric acid and *cis*-glutarimide.

The complete hydrolysis of the nitrile or imide is effected by 50 per cent. sulphuric acid.

III. In the condensation of ethyl bromoisobutyrate with ethyl sodioisobutyl-malonate or -cyanacetate in benzene solution: in the condensation of ethyl bromoisobutyrate with ethyl sodiocyanacetate in alcoholic solution with subsequent addition of isobutyl bromide.

Ethyl αα-dimethyl-α'-isobutyl-α'-cyansuccinate, b. p. 180° (20 mm.), $CO_2Et\cdot C(CH_3)_2\cdot CH(C_4H_9)(CN)(CO_2Et)$, when hydrolysed with alcoholic potash and then acidified, gives a pasty mass of cyano-acid—on complete hydrolysis with 50 per cent. sulphuric acid it gives *αα-dimethyl-α'-isobutylsuccinic acid,* $CO_2H\cdot C(CH_3)_2\cdot CH(C_4H_9)CO_2H$, prisms from water, m. p. 141°.

Experiments on the oxidation of methylisobutylglutaric acid (the study of which was the original object of this research) with potassium permanganate either at 60° or in the cold, showed that the greater part of the acid could be recovered unchanged, the oxidation products consisting of oxalic acid, isobutylmalonic acid, a fatty acid (isobutylacetic acid ?), two liquid acids, of which one appeared to be a hydroxy-acid, $C_{10}H_{18}O_5$, and the other an unsaturated acid, $C_{10}H_{16}O_4$, and a crystalline acid, m. p. 80°, of the same composition.

These acids were obtained in very small quantities and their complete separation was both difficult and probably unsuccessful.

100. "Methylisoamylsuccinic acid. II." By W. Trevor Lawrence, B.A., Ph.D.

The anil of *trans*-α-methyl-α′-isoamylsuccinic acid melts at 118°, and that of the *cis*-acid at 116°.

The partial conversion of the *cis*- into the *trans*-modification may be brought about by heating with hydrochloric acid, and the reverse change by heating the *trans*-acid with acetic anhydride at 210°.

The *cis*-anhydride is converted by phosphorus pentabromide, bromine, and alcohol into ethyl α-bromomethylisoamylsuccinate (b. p. 155°, 20 mm.), $C_{14}H_{25}O_4Br$, which, when poured into hot alcoholic potash forms the potassium salt of isoamylcitraconic acid,

$$CO_2H\cdot C(CH_3)\colon C(C_5H_{11})\cdot CO_2H.$$

Oxidation of methylisoamylsuccinic acid by means of potassium permanganate gave results similar to those obtained by the oxidation of the isomeric methylisobutylglutaric acid (compare preceding abstract); only a small portion of the acid was oxidised by the permanganate, giving oxalic acid, a liquid acid having the formula $C_{10}H_{16}O_4$, and a lactonic acid having the same formula and melting at 103°.

Correction.—Isoamylsuccinic acid melts at 83—84°, not 76° as previously stated (*Proc.*, 1899, 15, 163).

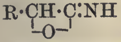
101. "The estimation of furfural." By William Cormack.

The process proposed by the author is based on the oxidation of furfural to pyromucic acid by means of an ammoniacal solution of silver oxide, according to the equation $C_5H_4O_2 + Ag_2O = C_5H_4O_3 + 2Ag$. The action takes place quantitatively when the solutions are warmed. A known volume of a decinormal silver oxide solution, somewhat in excess of that required for the oxidation of the furfural, is added to the furfural solution, the reduced silver is filtered off through asbestos, and the silver remaining in the filtrate estimated by means of decinormal ammonium thiocyanate.

The method is applicable to furfural solutions such as those derived from fibres by distillation with hydrochloric acid, the furfural being distilled over with steam from the solution after neutralisation with alkaline carbonate, and subsequent slight acidification with oxalic acid.

102. "The constitution of hydrogen cyanide." By John Wade.

When potassium cyanide is heated with alkyl potassium sulphates at a lower temperature than in the preparation of nitriles, the isomeric isocyanide is often the principal product. The author also has found that practically all the isocyanides can be converted into nitriles by the action of heat. The formation of nitriles in the above interaction is thus accounted for, and one of the arguments in favour of the nitrilic constitution of hydrogen cyanide disappears.

Isocyanides form crystalline products with aldehydes, probably homologous with the aldehyde cyanhydrins, for which the formula  $\mathrm{R\cdot}\underbrace{\mathrm{CH\cdot C}}_{\mathrm{O}}\mathrm{:NH}$ is suggested, as the ordinary formula does not account for their anomalous behaviour with alkalis. Compounds have in this way been obtained from acetaldehyde and benzaldehyde in conjunction with methyl-, ethyl- and phenyl-isocyanides.

Isocyanides also form crystalline products with alkyl iodides in presence of alcohol. This interaction accounts for the non-appearance of isocyanides, and probably for the formation of nitriles, when potassium cyanide is heated with alkyl iodides in presence of alcohol. Compounds of this class have been obtained from methyl-, ethyl-, propyl-, isopropyl-, butyl-, isoamyl-, and phenyl-isocyanides in conjunction with methyl, ethyl, propyl, isopropyl, isobutyl, and isoamyl iodides.

n-*Propyl isocyanide*, and n-*butyl isocyanide* do not appear to have been prepared before. They are formed by interaction of the alkyl iodides with silver cyanide, and boil respectively at 97—99° and 118—120° (uncorr.).

103. "Inhibiting effect of etherification on substitution in phenols."

By Henry E. Armstrong and Edward W. Lewis.

The inhibiting effect on substitution produced by introducing methyl, ethyl or benzyl in place of the hydroxylic hydrogen in phenolparasulphonic acid has already been referred to (Armstrong, *Proc.*, 1899, **15**, 177). At the last meeting of the British Association, it was pointed out that "benzoyl appears to exercise a very remarkable inhibitive effect, as preliminary experiments show that benzoylated phenolparasulphonic acid remains unattacked by bromine under conditions which involve the conversion of the unbenzoylated acid into tribromophenol." This observation has since been confirmed, and the experiments have been extended in order to determine the effect of radicles generally. Besides benzoyl, phenylsulphonyl, $\mathrm{Ph{\cdot}SO_2{\cdot}}$, benzylsulphonyl, $\mathrm{Ph{\cdot}CH_2{\cdot}SO_2{\cdot}}$, and the radicle of Reychler's camphorsulphonic acid, $\mathrm{C_{10}H_{15}O{\cdot}SO_2{\cdot}}$, afford complete protection against bromine. Picryl, $\mathrm{C_6H_2(NO_2)_3{\cdot}}$, also appears to behave like benzoyl, but owing to the instability of picrylphenolparasulphonate in aqueous solution it is difficult to determine the exact nature of the change effected by bromine. Acetyl, on the other hand, exercises an effect similar to that produced by methyl and ethyl; and the complex radicle phenacyl, Ph·CO·CH_2·, derived from acetophenone, acts much in the same way as acetyl. Difficulty has been experienced in determining the influence of the isomeric radicle phenacetyl, Ph·CH_2·CO·, owing to the instability of the ether produced by it; apparently, it also resembles acetyl.

In order to ascertain whether a determining influence is exercised by hydrogen in association with the carbon atom which becomes attached to the phenolic oxygen, tertiary butyl was introduced into phenolparasulphonate. The effect produced by this radicle seems to be altogether different from that of either methyl or ethyl, because on treating the sulphonate with one molecular proportion of bromine, only monobromosulphonate is obtained, the sulphonic radicle remaining intact, but it is displaced by a second molecular proportion of bromine; the methyl and ethyl derivatives are, to a large extent, directly converted into the parabromophenol ethers. In view of this observation it will be necessary to examine other alkyl derivatives.

104. "Bromination of oxyazo-compounds." By Henry E. Armstrong and Percy C. C. Isherwood.

The observations recently made by Hewitt and Aston and by Auwers unquestionably prove that the compound formed by the interaction of phenol and a diazobenzene salt, behaves, in the main, as benzeneazophenol, and there is no doubt that the isodynamic hydrazone comes prominently into evidence only in the presence of acids; it is clear, however, that the equilibrium is easily disturbed in either direction, and that in such a case the constitution *can only* be finally inferred from physical rather than chemical properties.

The authors must confess to having been too much influenced by the extraordinary difference in the behaviour of this compound towards excess of bromine as compared with that of its ethylated derivative, but apparently it is not necessary to infer from this that the two are structurally different, as the principle developed by one of them in discussing the laws which govern substitution in benzenoid compounds suffice to afford an explanation of the dissimilarity.

The conversion of benzeneazophenol into benzeneazodibromophenol and its resolution by excess of bromine into diazobenzene and tribromophenol are comparable with the conversion of phenolparasulphonic acid, first into the dibromosulphonate, and then into tribromophenol and sulphuric acid.

Ethylation exercises an inhibiting influence such as is referred to in the previous abstract, benzeneazophenetol being converted by bromine in presence of sodium acetate only into benzeneazomonobromophenetol. This compound is also formed when a solution of the phenetol in glacial acetic acid is brominated, but at the same time a "hydrobromide perbromide" is formed which is readily deprived of its bromine by reducing agents. In a previous note (*Proc.*, 1899, **15**, 243), the mistake was made of inferring from observations made with this latter compound that benzeneazo-orthobromophenetol is an easily reducible substance.

As the separation of the azo-group from Hewitt and Aston's benzeneazodiorthobromophenol by bromine is effected even in presence of sodium acetate, it cannot be argued that the scission is consequent on the formation of the hydrazone, and the stability of benzeneazophenetol must therefore be ascribed to the change produced by displacing the hydroxylic hydrogen. The extreme readiness with which the compound assumes the hydrazone form is manifest from the fact that if the sodium acetate be omitted and two molecular proportions of bromine are used, the substance being merely dissolved in acetic acid, benzeneazodiorthobromophenol is mainly resolved into bromodiazobenzene and tribromophenol. Benzoylated benzeneazophenol, like benzoylated phenolparasulphonic acid, is unaffected by bromine.

Clearly, it will be desirable to study further oxy- as well as amidoazo-compounds from the points of view indicated in the preceding abstract.

105. "Meta-sulphonation of aniline." By Henry E. Armstrong and W. Berry.

It has been pointed out by one of the authors that, "in order to produce meta-derivatives from amines, it is necessary to paralyse, as far as possible, the ordinary ortho-para-orientating influence of the amino-group and to give opportunity for the attack to take place in the nucleus" (*Proc.*, 1899, **15**, 177; compare *B. A. Report*, 1899, 685, § 11).

In the case of aniline, sulphuric acid alone appears to be capable of exercising the necessary protective influence, because if the sulphate be dissolved in a large excess of chlorosulphonic acid, the mixture may be heated to 30—40° without any appreciable amount of hydrogen chloride being evolved. Under these conditions, the chlorosulphonic acid is not a sufficiently powerful sulphonating agent to produce even the sulphamate. Consequently, if aniline sulphate be added to a sufficiently strong fuming sulphuric acid, it is in part converted into the metasulphonic acid, the nucleus apparently being directly attacked. It is therefore possible to convert aniline into either para- or ortho- or meta-sulphonic acid at will.

106. "Phenylacetylchloramine and analogous compounds." By Henry E. Armstrong.

The author calls attention to the discrepancies in the descriptions given of the properties of phenylacetylchloramine, and discusses the manner in which it undergoes isomeric change.

107. "Benzylanilinesulphonic acids." By Ida Smedley.

These acids have been prepared in order to compare their behaviour with that of the corresponding methyl and ethyl derivatives studied by Miss Evans (*Proc.*, 1895, **11**, 235; 1896, **12**, 234).

Anilineparasulphonic acid is readily benzylated by digesting an aqueous solution of its sodium salt with benzyl chloride and alkali, the mono- or di-benzyl derivative being formed according to the proportions used. The meta-acid is dibenzylated with extreme readiness.

In their behaviour with bromine, the dibenzylated closely resemble the dimethylated acids. It may therefore be assumed that benzyl does not promote the displacement of the sulphonic group as it does when introduced into phenolparasulphonic acid in place of the hydroxylic hydrogen, but it undoubtedly has an influence different from that exercised by either methyl or ethyl. Thus it is characteristic of dimethyl- and diethyl-sulphanilic acids that, when acted on by bromine, each is converted into an ortho-brominated acid capable of combining with bromine to form a comparatively stable perbromide. The dibenzyl acid yields a similar monobrominated acid, but this does not form a perbromide; it is, however, very easily deprived of its benzyl by the further action of bromine.

108. "Benzeneorthodisulphonic acid." By Henry E. Armstrong and S. S. Napper.

The authors have prepared benzeneorthodisulphonic acid by applying Leuckart's xanthate method (*J. pr. Chem.*, 1890, **41**, 179) to parabromanilineorthosulphonic acid. A series of compounds has thus been obtained corresponding with those prepared by Miss Walter (*Proc.*, 1895, **11**, 141) from sulphanilic acid.

Potassium parabromophenylxanthateorthosulphonate is easily soluble in water, from which it crystallises with 10 molecules of water.

When hydrolysed by means of sulphuric acid or alcoholic potash, it yields the corresponding thiophenolsulphonic acid, $C_6H_3Br(SH)\cdot SO_3H$, or its potassium salt, the thiophenetolsulphonate, $C_6H_3Br(SEt)\cdot SO_3K$, being also formed when it is hydrolysed by aqueous potash, and when it is decomposed by heating at about 200°.

Bromobenzene-3 : 4-disulphonic acid is conveniently prepared by directly oxidising the xanthate with potassium permanganate. Its sulphochloride crystallises in monosymmetric prisms melting at 88°. The amide crystallises in brilliant anorthic prisms; the anilide in monosymmetric plates melting at 182°. It is converted into benzeneorthodisulphonic acid by boiling its aqueous solution with soda and zinc dust.

Sodium benzeneorthodisulphonate is very soluble in water, from which it crystallises in long, transparent prisms. The barium salt is sparingly soluble even in hot water, and crystallises in glistening plates.

Unlike 1:2-naphthalene-1:2-orthodisulphonic acid, but like toluene-3:4-disulphonic acid, benzeneorthodisulphonic acid is converted into the corresponding chloride by phosphorus pentachloride. This crystallises in magnificent monosymmetric prisms melting at 143°. ✓

The corresponding amide and anilide also crystallise in monosymmetric prisms, the former melting at 252°, the latter at 241°.

A comparison of the acid with phthalic acid is being made.

109. "An isomeride of furfurine." By J. P. Millington, B.Sc., and H. Hibbert, B.Sc.

By the application of the method of Japp and Moir (*Trans.*, 1900, 77, 637) for the preparation of isoamarine from amarine the authors have succeeded in preparing an isomeride of furfurine. It crystallises from water in needles melting sharply at 143° (furfurine melts at 116°) and on analysis was found to correspond with the formula $C_{15}H_{12}N_2O_3$. A platinichloride and silver derivative have been obtained of which the formulæ are $(C_{15}H_{12}N_2O_3)_2H_2PtCl_6$ and $C_{15}H_{11}N_2O_3Ag$ respectively.

110. The mono- and di-acetyl and phenacetyl diethyl tartrates. By J. McCrae and T. S. Patterson.

The preparation of monoacetyl, diacetyl, monophenacetyl, and diphenacetyl diethyl tartrates was described. Considerable difficulty was experienced in the purification, and different methods had to be adopted in each case. The specific rotation of these substances has been determined at various temperatures with the following results :—

Monoacetyl diethyl tartrate	$[\alpha]_D^{20}$ =	+9·30°
Diacetyl ,, ,, ...	$[\alpha]_D^{100}$ =	+6·30°
Monophenacetyl ,, ,, ...	$[\alpha]_D^{20}$ =	+30·38°
Diphenacetyl ,, ,, ...	$[\alpha]_D^{20}$ =	+17·92°

A comparison is instituted, on the one hand, between the series of monoacidyl tartrates, where it is shown that the phenacetyl radicle exerts a much greater influence than that exerted by the acetyl radicle, and, on the other hand, between the members of the series of diacidyl tartrates where the acetyl and phenacetyl radicles behave similarly but very differently from the toluyl radicles.

The regularity of the influence exerted by the successive introduction of two acidyl groups is noticed. The first acidyl group increases the rotation of the diethyl tartrate, but the second acidyl group diminishes the rotation of the monoacidyl compound.

NILSON MEMORIAL LECTURE.

The Nilson Memorial Lecture will be delivered by Professor Otto Pettersson, of Stockholm, on the evening of Thursday, July 5th, 1900. The Chair will be taken at 8.30.

LIBRARY.

The Library will be closed for stock-taking during the first fortnight of August. Fellows are requested to return all Library books in their possession **before July 28th.**

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

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July 5th. Extra Meeting. Professor THORPE, C.B., F.R.S., President, in the chair.

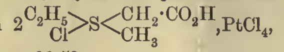
Professor OTTO PETTERSSON, of Stockholm, delivered the Nilson Memorial Lecture.

On the motion of Dr. ARMSTRONG, seconded by Professor DEWAR, a vote of thanks was passed to Professor Pettersson for his Lecture.

The following are abstracts of the papers received during the vacation, and published in the *Transactions* :—

111. "Asymmetric optically active sulphur compounds; *d*-methylethylthetine platinichloride." By W. J. Pope and S. J. Peachey.

Although the earlier attempts of the authors to resolve methylethylthetine into optically active components were unsuccessful, they have since succeeded in preparing *d*-methylethylthetine platinichloride. Methylethylthetine bromide was treated with silver *d*-camphorsulphonate. The residue, after evaporation at a low temperature, was dissolved in absolute alcohol and precipitated by the addition of anhydrous ether, and this treatment repeated about 40 times, when a sparingly soluble fraction was obtained, which seems to be *d*-methylethylthetine *d*-camphorsulphonate. It melts at 118—120°, and gives $[\alpha]_D = +18{\cdot}6°$ and $[M]_D = +68{\cdot}0°$.

The *d*-bromocamphorsulphonate was similarly prepared. When either of these salts is dissolved in absolute alcohol, a little strong hydrochloric acid and an alcoholic solution of platinic chloride added, a yellow, crystalline platinichloride is deposited, having the constitution  $2\genfrac{}{}{0pt}{}{C_2H_5}{Cl}{>}S{<}\genfrac{}{}{0pt}{}{CH_2\cdot CO_2H}{CH_3},PtCl_4$, and giving $[\alpha]_D = +4{\cdot}5°$ and $[M]_D = +30{\cdot}5°$.

112. "Sulvanite, a new mineral." By G. A. Goyder.

This mineral was found in considerable quantity in some ore from a new mine near the Burra in South Australia. It appears to afford the first recorded instance of a sulphide mineral containing vanadium as one of its principal constituents.

The analyses given show that it consists of cuprous sulphovanadate, $3Cu_2S,V_2S_5$. Its hardness is 3·5, and its specific gravity 4·0.

113. "Estimation of atmospheric carbon dioxide." By James Walker.

A modification of Pettenkofer's bottle method is described which gives results accurate to 0·1 vol. carbon dioxide in 10,000 vols. air, when a bottle of 2·6 litres capacity (Winchester quart) is employed. The usual error due to absorption of carbon dioxide during titration is avoided by filtering the residual baryta solution into a known quantity of hydrochloric acid, and titrating back with standard baryta. The filtration takes place under diminished pressure through asbestos contained in a Soxhlet filter tube, atmospheric air being entirely excluded during the process of filtering and washing. No special apparatus is employed, and an estimation occupies only half an hour.

114. "On some periodides of substituted oxonium derivatives." By J. N. Collie, F.R.S., and B. D. Steele, B.Sc.

During the investigation of the salts of tetramethylpyrone, it was noticed that when the solution of the iodide was allowed to evaporate in the air brownish crystals slowly separated, which were nearly insoluble in water. From their properties they seemed to resemble the periodides of the pyridine bases. It was found that when free iodine in potassium iodide solution was added to a solution of the hydriodide of tetramethylpyrone or of dimethylpyrone, an immediate crystalline precipitate was produced.

These periodides have the following constitution: from dimethylpyrone, $C_7H_8O_2HI,I_2$; from tetramethylpyrone, $C_9H_{12}O_2HI,I_2$. They lose iodine when heated, and are at once converted into di- and tetra-methylpyrone when treated with a solution of soda.

The action of iodine on the barium and sodium salts of dimethylpyrone proceeds in a quite different manner. The chief product is an oxidised iodine compound, $C_7H_7IO_3$, which possesses rather remarkable properties; it is not decomposed when warmed with solutions of soda or sodium ethylate, but gives free iodine at once when warmed with a mineral acid.

115. "Condensation of phenols with esters of the acetylene series. II. Action of phenols on ethyl phenylpropiolate and ethyl acetylenedicarboxylate." By Siegfried Ruhemann and Fred Beddow.

The authors describe ethyl-*β*-*m*-cresoxycinnamate and the products of its transformation as well as the reaction between phenols and ethyl acetylenedicarboxylate. They find that in the latter case aryl ethers of ethyl hydroxyfumarate are formed, and not the ethers of ethyl hydroxymaleate, which were expected; this has been proved by a comparison of the products with the compounds obtained by the action of the sodiophenolates on ethyl chlorofumarate. The aryl ethers of ethyl hydroxyfumarate, on hydrolysis with alcoholic potash, give the corresponding acids, which on heating are partially transformed into the aryl ethers of hydroxymaleic acid; these differ from their stereoisomerides in that lead acetate gives with their aqueous solutions precipitates of their lead salts, but not with the aryl ethers of hydroxyfumaric acid.

116. "The vapour pressures, specific volumes, and critical constants of di-isopropyl and di-isobutyl. By Sydney Young, D.Sc., F.R.S., and Emily C. Fortey, B.Sc.

The results here given, taken in conjunction with those of previous researches, show that an iso- or di-iso-paraffin bears very much the same relation to the isomeric normal paraffin as a lower does to a higher homologue. Thus the ratios of the absolute temperatures to the absolute critical temperatures, and of the volumes of saturated vapour to the critical volumes at corresponding pressures, as well as of the actual to the theoretical densities at the critical points, are higher for the normal paraffins, whilst the ratios of the volumes of liquid to the critical volumes at corresponding pressures are lower.

It was found that di-isopropyl shows marked peculiarities; it is exceptionally difficult to prepare by any method involving the combination of two $(CH_3)_2CH\cdot$ groups; the specific gravity at 0° and the critical pressure are higher than those of normal hexane, whereas these constants in all other known cases are lower for the iso- and di-iso-paraffin than for the normal isomerides; the critical density, the critical temperature, and the boiling point are also exceptionally high.

117. "The vapour pressures, specific volumes and critical constants of normal octane." By Sydney Young, D.Sc., F.R.S.

The normal octane was obtained from Kahlbaum, and was easily purified by treatment with sulphuric and nitric acids and subsequent fractional distillation.

A comparison of the data for normal pentane, hexane, heptane and octane shows that the ratios of the absolute temperatures at any series of corresponding pressures to the absolute critical temperatures, and also the ratios of the actual to the theoretical densities at the critical points, increase slightly with rise of molecular weight, whilst the ratios of the volumes of liquid at corresponding pressures to the critical volumes diminish slightly.

The ratios of the volumes of saturated vapour to the critical volume are, on the whole, very slightly lower than for normal heptane, but are higher than for hexane or pentane.

118. "Separation of neobornylamine from bornylamine." By M. O. Forster, and J. Hart-Smith, A.R.C.S.

In the course of attempts to separate neobornylamine from bornylamine, in addition to the *hydrobromide*, *hydriodide*, *nitrate*, *sulphate*, and *benzoate* of bornylamine, the following substances have been obtained.

Camphoroximeacetic acid, $C_{10}H_{16}:NO\cdot CH_2\cdot CO_2H$, which melts at 100—102°, and gives $[\alpha]_D = -5\cdot9°$; the *sodium* and *bornylamine* salts are well defined.

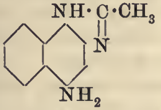
Bornyloxamide, $C_{10}H_{17}\cdot NH\cdot CO\cdot CO\cdot NH_2$, melting at 162°, which gives $[\alpha]_D = -24\cdot1°$.

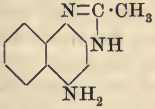
Dibornyloxamide, $C_{10}H_{17}\cdot NH\cdot CO\cdot CO\cdot NH\cdot C_{10}H_{17}$, which melts somewhat indefinitely at 140°, and gives $[\alpha]_D = -29\cdot6°$.

Purified neobornylamine melts at 184°, and has $[\alpha]_D = -43\cdot7°$ in absolute alcohol. The *benzylidene* derivative is an oil which boils at 180° under 25 mm. pressure.

119. "Aminoamidines of the naphthalene series." By Raphael Meldola, F.R.S., and Lewis Eynon, A.I.C.

It has been found by the authors that when dinitro-α-acetnaphthalide is reduced by iron and hydrochloric acid (Markfeldt, *Ber.*, 1898, 31, 1174), the ethenyltriaminonaphthalene produced is isomeric and not identical with that obtained when tin and hydrochloric acid are used (Meldola and Streatfeild, *Trans.*, 1887, 51, 691). In this paper it is shown that the isomerism is entirely attributable to the reducing agent, since the same dinitro-α-acetnaphthalide has been used throughout. Descriptions and analyses are given of Markfeldt's base and some of its salts, of the acetyl derivatives of both bases and their salts and of the isomeric phenylazo-derivatives. The pronounced difference in the properties of the latter compounds first indicated the isomerism of the respective anhydro-bases. It is suggested that the isomerism may be explained by the structural differences indicated by the formulæ :



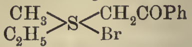


Experiments with the object of determining the constitution of the amino-amidines have been commenced, and the research will be extended in this direction. When the NH_2 group in Markfeldt's base is replaced by hydrogen by the diazo-method an ethyldiamino naphthalene is obtained which is apparently identical with that Prager (*Ber.*, 1885, **18**, 2161).

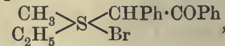
120. "Note on the elimination of a nitro-group during diazotisation." By Raphael Meldola, F.R.S., and Elkan Wechsler.

When acetorthoanisidide is nitrated with excess of fuming nitric acid in the cold in acetic acid solution, a dinitroacetanisidide is formed. This compound crystallises in light yellow needles melting at 162—163°, and on hydrolysis by alcoholic sodium hydroxide gives a dinitroanisidine, crystallising in bright orange needles having a melting point of 186—188°. This dinitroanisidine, on treatment with sodium nitrite and an acid, forms a diazo-compound which crystallises in ochreous scales or yellow needles, having an exploding point of about 178°. The diazo-compound has the formula $NO_2 \cdot C_6H_3(OCH_3) \cdot N_2 \cdot OH$, so that one nitro-group is eliminated during the process of diazotisation. The corresponding iodonitromethylresorcinol crystallises in flat, yellow needles melting at 115—116°. The nitroazo-β-naphthol derivative, obtained by combining the diazo-compound with β-naphthol in alkaline solution, forms glittering, bronzy-green scales decomposing at about 250°. The constitution of the new dinitroanisidine is being investigated with the object of determining the particular configuration which is favourable to this easy displacement of a nitro-group.

121. "A contribution to the stereochemistry of sulphur; an optically active sulphine base." By S. Smiles, B.Sc.

Methyl ethyl sulphide unites with ω-bromacetophenone to form *methyl-ethyl-phenacylsulphine bromide*,  $\genfrac{}{}{0pt}{}{CH_3}{C_2H_5}>S<\genfrac{}{}{0pt}{}{CH_2COPh}{Br}$; this, when treated in alcoholic solution with silver dextro-α-bromocamphorsulphonate, gives rise to two salts, the molecular rotation of the less soluble of which is +250°, and of the more soluble +289°. This points to the fact that the basic methyl ethyl phenacyl radicle possesses a molecular rotation in aqueous solution of over 20°.

From the less soluble salt a lævorotatory sulphine picrate was obtained as yellow needles (m. p. 125°) for which $[\alpha]_D = -9{\cdot}3^\circ$ and $[M]_D = -39{\cdot}3^\circ$. The dextrorotatory picrate obtained from the more soluble salt (yellow needles, m. p. 123—124°) gave $[\alpha]_D = +8{\cdot}1^\circ$ and $[M] = +34{\cdot}2$.

It was not found possible, however, to separate two stereoisomers from methyl-ethyl-desyl-sulphine bromide,  $\genfrac{}{}{0pt}{}{CH_3}{C_2H_5}>S<\genfrac{}{}{0pt}{}{CHPh{\cdot}COPh}{Br}$, which was obtained as a colourless mass of deliquescent needles.

122. "Condensation of phenols with esters of the acetylene series. Synthesis of benzo-γ-pyrone." By S. Ruhemann and H. E. Stapleton.

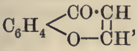
By the condensation of guaiacol and thiophenol with esters of the acetylene series the authors have obtained

$C_6H_5{\cdot}C(OC_6H_4{\cdot}OCH_3){:}CH{\cdot}CO_2Et$ and $C_6H_5{\cdot}C(SC_6H_5){:}CH{\cdot}CO_2Et$;
Ethyl β-*o*-methoxyphenoxycinnamate. Ethyl β-thiophenylcinnamate.

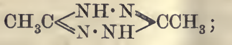
these esters, on hydrolysis with alcoholic potash, give the corresponding acids which lose carbon dioxide and yield respectively

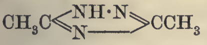
$C_6H_5{\cdot}C(OC_6H_4OCH_3){:}CH_2$ and $C_6H_5{\cdot}C(SC_6H_5){:}CH_2$.
o-Methoxyphenoxystyrene. Thiophenylstyrene.

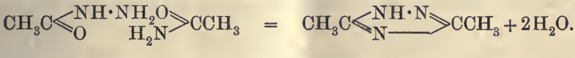
Ethyl acetylenedicarboxylate condenses with thiophenol to ethyl thiophenylfumarate, which is decomposed by alcoholic potash, forming phenyl disulphide $(C_6H_5S)_2$. Along with the ethyl thiophenylfumarate, ethyl dithiophenylsuccinate is also formed, having probably the formula $CO_2Et{\cdot}C(SC_6H_5)_2{\cdot}CH_2{\cdot}CO_2Et$. The analogous oxygen compound, along with ethyl β-phenoxyfumarate, is obtained by the action of phenol on ethyl acetylenedicarboxylate.

Ethyl β-phenoxycinnamate, by treatment with strong sulphuric acid, is not condensed into flavone, but decomposes into benzoylacetic acid along with oxalic and acetic acids. Ethyl phenoxyfumarate, however, partially undergoes the desired change, forming benzo-γ-pyronecarboxylic acid, which, on heating, loses carbon dioxide, giving benzo-γ-pyrone,  $C_6H_4{<}\begin{matrix}CO\cdot CH\\ \|\\ O-CH\end{matrix}$, melting at 59°.

123. "Contributions to the chemistry of hydrotetrazines and triazoles." By Oswald Silberrad, Ph.D.

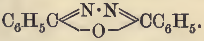
The action of hydrazine hydrate on diacetanilide gives dimethyldihydrotetrazine,  $CH_3C{<}\begin{matrix}NH\cdot N\\ N\cdot NH\end{matrix}{>}CCH_3$; its hydrochloride melts at 232°. Benzoyl chloride decomposes it with the formation of *sym*-dibenzoyl-hydrazine and acetic acid.

Nitrous acid converts it into dimethyltriazole nitrate (m. p. 125°), from which the hydrochloride (m. p. 199°) and the free base,  $CH_3C{<}\begin{matrix}NH\cdot N\\ N\text{———}\end{matrix}{>}CCH_3$ (m. p. 142°, b. p. 258° at 752 mm.), may be obtained. Its constitution is evident from its synthesis from acetamide and acetylhydrazine,



$$CH_3C{<}\begin{matrix}NH\cdot NH_2O\\ O \qquad H_2N\end{matrix}{>}CCH_3 = CH_3C{<}\begin{matrix}NH\cdot N\\ N\text{———}\end{matrix}{>}CCH_3 + 2H_2O.$$

Diphenyldihydrotetrazine, $C_6H_5C{<}\begin{matrix}NH\cdot N\\ N\cdot NH\end{matrix}{>}CC_6H_5$, may be obtained in almost theoretical quantity by heating benzoylhydrazine with hydrazine hydrate to 230°. It melts at 264°. Pinner gives 258° (*Ber.*, 1894, 27, 1006).

Heated alone, benzoyl-hydrazine yields only traces of diphenylhydrotetrazine, the chief products being diphenyltriazole, $C_6H_5C{<}\begin{matrix}N\cdot N\\ NH\end{matrix}{>}C\cdot C_6H_5$, and diphenyl diazoxole,  $C_6H_5C{<}\begin{matrix}N\cdot N\\ -O-\end{matrix}{>}CC_6H_5$.

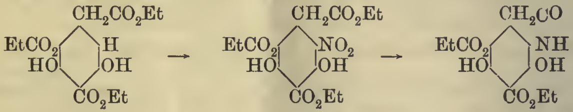
αα-Benzoylphenylhydrazine under similar treatment does not condense, but breaks down with production of benzophenone, benzoic acid and benzoylanilide.

124. "Isomeric dibenzylketone benzalanilines and deoxybenzoinbenzalanilines." By Francis E. Francis, Ph.D., B.Sc.

Three isomeric addition products of the two ketones, dibenzyl ketone and deoxybenzoin, with benzalaniline are described. For the sake of convenience these are termed *α*-, *β*-, *γ*-modifications. The *α*- is obtained from the pure ketone, the *β*- by the action of traces of piperidine on the *α*- or with greater difficulty on the *γ*-, the *γ*- by the action of traces of sodium ethylate on either the α- or β-. By the action of heat, the β- and γ- are transformed into the α-modification. The dibenzyl ketone benzalanilines are more basic than the deoxybenzoin benzalanilines, the former yield normal, whilst the latter give basic hydrochlorides. These salts are different in the case of α- and β- but identical in β- and γ-. They are dissociated by water, giving the corresponding base, but with alcohol the α-hydrochloride appears to give a mixture of α- and γ-base, whereas the β- or γ- gives the α-modification nearly pure.

125. “Condensation of methylic acetonedicarboxylate. Constitution of orcinoltricarboxylic esters.” By F. W. Dootson, M.A.

It is shown that a moderate temperature is sufficient to condense methyl acetonedicarboxylate to trimethyl orcinoltricarboxylate, and that a good yield of the latter is obtained. The constitution assigned to ethyl orcinoltricarboxylate by Jerdan is confirmed, and the similarity of the methyl and ethyl esters is shown by nitration and subsequent reduction, when a lactam structure results in both cases, proving that in orcinoltricarboxylic esters the remaining hydrogen atom of the benzene nucleus is in the ortho-position to the side chain, thus:



126. “Contribution to the chemistry of the aromatic meta-diamines.” By G. F. Morgan, D.Sc.

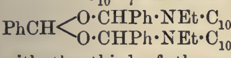
In this paper the following compounds are described: 1-*bromo*-2 : 4-*phenylenediamine* melting at 111—112°; its *dibenzoyl* and its *diacetyl* derivatives melting at 178·5° and 198° respectively; *dibenzoyl* 1-*chloro*-2 : 4-*phenylenediamine*, m. p. 178°, and *chlorochrysoidine*, $PhN_2C_6H_2Cl(NH_2)_2$, m. p. 149°; m-*phenylenediacetyldichloramine*, $C_6H_4(NCl{\cdot}Ac)_2$, m. p. 150—151°; *diacetyl*-1 : 5-*dichloro*-2 : 4-*phenylenediamine*, m. p. above 260°; 1 : 5-*dichloro*-2 : 4-*phenylenediamine* melting at 136—137° and its *dibenzoyl* derivative at 187°.

Diacetyl-*m*-toluylenediamine, when chlorinated and then hydrolysed, gives 5-*chloro*-2 : 4-*tolulylenediamine*, m. p. 120—121°; its *diacetyl* derivative melts at 239—240°.

127. "Action of aromatic aldehydes on derivatives of β-naphthylamine." By Gilbert Thomas Morgan, D.Sc.

The *compound*, $C_{48}H_{42}N_2O_2$, produced by the condensation of ethyl β-naphthylamine (2 mols.) with benzaldehyde (3 mols.), crystallises in colourless leaflets and melts at 148°. Its constitution may be represented by one of the following formulæ: $Ph{\cdot}CH(NEt{\cdot}C_{10}H_7)_2,2Ph{\cdot}COH$;

$$C_{10}H_7NEtCHPh{\cdot}O{\cdot}CHPh{\cdot}NEt{\cdot}C_{10}H_7,PhCOH\ ;$$



$$PhCH{<}\begin{matrix}O{\cdot}CHPh{\cdot}NEt{\cdot}C_{10}H_7\\O{\cdot}CHPh{\cdot}NEt{\cdot}C_{10}H_7\end{matrix}.$$

Its general behaviour is in accordance with the third of these; but freezing point determinations seem to indicate that the substance, dissolved in benzene, corresponds with the second formula.

The following anhydro-bases and their hydrocyanides, derived from 1-chloro-2-naphthylamine and its bromine analogue, are also described in the paper: *benzylidene*-1-*bromo*-2-*naphthylamine*, m. p. 93—94°, and its *hydrocyanide*, m. p. 92°; the *cuminylidene* derivative and its *hydrocyanide*, melting at 100—101° and 120° respectively; the p-*hydroxybenzylidene* and o-*hydroxybenzylidene* derivatives, melting respectively at 189—190° and 144°, and the corresponding *hydrocyanides* at 144° and 152°; p-*methoxybenzylidene*-1-*bromo*-2-*naphthylamine* and its *hydrocyanide*, melting at 107° and 140—143°; *cinnamylidine*-1-*bromo*-2-*naphthylamine*, m. p. 126°, and its *hydrocyanide*, m. p. 142—143°; *benzylidene*-1-*chloro*-2-*naphthylamine* and the corresponding *cuminylidene* derivative, melting respectively at 99° and 85°, and their *hydrocyanides* at 77° and 117°; *cinnamylidene*-1-*chloro*-2-*naphthylamine*, m. p. 134°, and its *hydrocyanide*, m. p. 155—156°; p-*hydroxybenzylidene*-1-*chloro*-2-*naphthylamine* and the corresponding *ortho-isomeride*, melting respectively at 191° and 153°, and their *hydrocyanides* at 152° and 148°; p-*methoxybenzylidene*-1-*chloro*-2-*naphthylamine*, m. p. 117°, and its *hydrocyanide*, m. p. 132°.

The following anhydro-bases do not combine with hydrogen cyanide: o-*nitrobenzylidene*-1-*chloro*-2-*naphthylamine*, m. p. 142°, and the corresponding *bromo*-compound, melting at 138°; p-*nitrobenzylidene*-1-*chloro*-2-*naphthylamine*, m. p. 151°, and its bromine analogue, melting at 154—155°.

128. "Action of hydrogen peroxide on carbohydrates in the presence of ferrous salts. II." By R. S. Morrell, M.A., Ph.D., and J. M. Crofts, M.A., B.Sc.

Rhamnose when oxidised by hydrogen peroxide in the presence of ferrous sulphate yields an osazone which reacts with phenylhydrazine at the ordinary temperature to give rhamnosazone.

Similarly, cane sugar, when the hydrogen peroxide is neutral, is first 'inverted' and then oxidised, since on testing with phenylhydrazine, glucosazone is precipitated.

The action of potassium persulphate on glucose in the presence of ferrous sulphate is slow at ordinary temperatures. On warming to 40°, oxidation proceeds more rapidly with formation of glucosone. The yield of the glucosone (measured by the weight of the glucosazone precipitate) is smaller than when hydrogen peroxide is employed as the oxidising agent.

129. "The specific gravities of the halogens at their boiling points, and of oxygen and nitrogen." By J. Drugman, Ph.D., and W. Ramsay, F.R.S.

The determinations made by the authors of the specific gravities of the halogens at their respective boiling points under atmospheric pressure have given the following results:

Iodine	boiling at	184·5°	has the	sp. gr.	3·706
Chlorine	,,	−33·6°	,,	,,	1·507
Fluorine	,,	−187°	,,	,,	1·108

The specific gravity of fluorine was arrived at by using the data of Moissan and Dewar (*Proc.*, 1897, 13, 180) and calculating the specific gravity at its boiling point, corrections being made for the expansion of the liquid fluorine and the change in the specific gravity of amber. Amber was found to have the specific gravity 1·065 at 15° and 1·10 at −187°. The specific gravities of oxygen and nitrogen were found to be 1·1315 and 0·7914 at their respective boiling points.

130. "On hydroferrocyanic acid." By K. C. Browning, B.A.

The purification and some of the properties of hydroferrocyanic acid are described. This acid begins to evolve hydrocyanic acid at 120°, and its decomposition is complete at 300°, ferrous cyanide being left as a pale yellow powder. Ferrous cyanide decomposes above 430° into iron, carbon and iron carbide. Reasons are given for considering it to be an isocyanide, but when strongly heated it seems to decompose partly as if it were a normal cyanide.

From the decomposition of ethyl ferrocyanide it would seem that all the cyanogen groups present have the isocyanide arrangement.

131. "On the nature of metal-ammonia compounds in aqueous solution. Part I." By H. M. Dawson and J. McCrae.

The nature of various ammoniacal salt solutions has been studied by determining the amount of ammonia extracted by shaking a known volume of the aqueous solution with a known volume of chloroform. If pure aqueous ammonia be shaken with chloroform at a constant temperature till equilibrium is established, this condition is characterised by the relationship $c_1/c_2 = \text{constant}\ (26{\cdot}3)$, where c_1 = concentration of ammonia in water and c_2 that in chloroform.

When this is done with ammoniacal solutions of cupric sulphate, cupric chloride, zinc sulphate, cadmium iodide, and nickel sulphate, the constant is found to give much higher values, and hence the amount in combination with the salt may readily be deduced. Experiments with calcium chloride solution also indicate the formation of a complex metal-ammonia compound, but the amount of ammonia combined per molecule of salt is very much smaller than in the case of the other salts investigated.

Experiments were also made with ammoniacal copper oxide solution which indicate that the base $Cu(NH_3)_2(OH)_2$ is probably formed; the copper sulphate compound has the formula $Cu(NH_3)_4SO_4$.

November 1st, 1900. Professor Thorpe, C.B., F.R.S., President, in the Chair.

Messrs. S. S. Napper, G. E. Tomlins, O. Silberrad, C. Watson, C. T. F. Watts, and H. F. F. B. Fermor were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Messrs. George Lowe Bennett, 13 St. Domingo Vale, Egerton, Liverpool; Frederick Nisbet Binks, 2 Hollywell Terrace, Millbourne Avenue, Drumcondra, Dublin; Herbert James Singleton Boyes, 9 Rua Episcopal, São Paulo, Brazil; Theodore Ridley Burnett, 83 Coltart Road, Liverpool; John Henry Cheesewright, 80 Sydney Road, Hornsey, N.; Albert Walker Comber, Rio Marina, I. d'Elba, Italy; Alexander Davidson, jun., 1 Almond Bank Terrace, North Merchiston, Edinburgh; Arthur Louis William Fechtner, 186 Spring bank, Hull; Willie Ludford Freeman, 102 Marlboro' Road, Oxford; William Gasson, Kimberley, South Africa; George William Gibbings, Standard Bank of South Africa, Ltd., Salisbury, Mashonaland; John Gibson, Battle Hill, Hexham, Northumberland; Walter Augustus Handcock, Southbank, 40 Avenue Road, Highgate, London; William Arthur Hargreaves, Port Adelaide, South Australia; George Harker, 35 Boulevarde, Petersham, Sydney, N.S.W. Frank C. R. Hemingway, Albyns, Forest Road, Walthamstow; John Brownlie Henderson, Brisbane, Queensland; Samuel Hewitt, 3 Chester Street, Norwich; William Henry Hewitt, 115 Fentiman Road, London, S.W. Adolf

Jappé, Broad Oak, Oak Avenue, Bradford; Humphrey Owen Jones, Clare College, Cambridge; George Washington Kilner, 14 St. John's Park, Upper Holloway, N.; Morris Charles Lamb, Herold's Institute, Drummond Road, Bermondsey, London, S.E.; George Druce Lander, 1 Balmoral Road, Nottingham; William McCall, Rio Marina, Isola d'Elba, Italy; Thomas Marginson Nightingale, 375 Bridgman Street, Bolton; Alexander Pardy, Pietermaritzburg, Natal, S. Africa; John Paul, Bacteriological Institute, Grahamstown, Cape Colony; Ernest Vivian Pearce, The Beeches, Hayle, Cornwall; Henry Ernest Stapleton, St. John's College, Oxford; Arthur Lambert Thornton, 2 Park Street Bolton; Ferdinand Gerhard Wiechmann, 771 West End Avenue, New York; George Sampson Valentine Wills, Southwood, Croham Road, South Croydon; Walter Bourne Woodbridge, Grey Friars, Chichester; Herbert Edwards Wright, 1 Brewers Street, St. Aldates', Oxford.

Of the following papers, those marked * were read :—

*132. "Action of alkalis on nitro-compounds of the paraffin series. Part II. The reactions and constitutions of methazonic acid and the formation of isoxazoles." By Wyndham R. Dunstan, F.R.S., and Ernest Goulding, B.Sc.

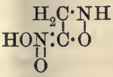
In a previous paper (Dunstan and Dymond, *Trans.*, 1891, **59**, 410) it was shown that trimethylisoxazole results from the action of alkalis on nitroethane, and triethylisoxazole from a similar action on nitropropane. Nitromethane, however, furnished no isoxazole, neither did secondary nitropropane.

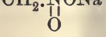
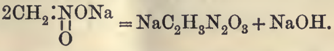
Further investigation has shown that the action of alkalis, preferably ammonia, on nitromethane leads to the production of the substance briefly described by Lecco under the name of *methazonic acid*, $C_2H_4N_2O_3$, and regarded by him as an anhydride of nitromethane. The authors have obtained this substance in colourless crystalline plates melting between 60° and 70°, and have prepared and described several of its salts. Both the acid and its salts, $AgC_2H_3N_2O_3$, $NH_4C_2H_3N_2O_3$, &c., are unstable, and are liable to explode when suddenly heated.

When heated with acids or alkalis, methazonic acid breaks up into *carbon dioxide*, *hydrogen cyanide*, and *hydroxylamine*, according to the equation $C_2H_4N_2O_3 = CO_2 + NH_2OH + HCN$. It is proved that one atom of nitrogen appears as hydrogen cyanide, and the other as hydroxylamine, whilst the carbon is equally divided between the carbon dioxide and the hydrogen cyanide.

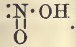
On oxidation with permanganate, chromic acid, or hydrogen peroxide, methazonic acid furnishes *carbon dioxide*, *hydrogen cyanide*, and *nitric acid*. On reduction either in acid or alkaline solution with weak or strong reducing agents, the principal products are *ammonia* and *formic acid*. No trace of ethylene-diamine or methylamine could be found.

Alkyl derivatives of methazonic acid can be prepared, but they are highly unstable.

The authors propose the formula  $\begin{array}{l} \quad H_2C\cdot NH \\ HON{:}C\cdot O \\ \quad \| \\ \quad O \end{array}$ for methazonic acid as satisfactorily accounting for its reactions.

Adopting the view of Nef that the "salts" of the nitroparaffins are to be regarded as derived from a tautomeride, and writing the formula of sodium nitromethane as  $CH_2{:}\underset{\underset{O}{\|}}{N}ONa$, the authors show how methazonic acid is formed by a process of intermolecular oxidation followed by condensation of the nitromethane residue with formaldoxime simultaneously produced,  $2CH_2{:}\underset{\underset{O}{\|}}{N}ONa = NaC_2H_3N_2O_3 + NaOH$.

By a similar process of intermolecular oxidation, followed by condensation with an oxime, it is shown how trimethylisoxazole, acetonitrile, and sodium nitrite are formed by the action of alkalis on nitroethane and how triethylisoxazole and similar products result from the action of alkalis on primary nitropropane; also, how secondary nitropropane gives no isoxazole, but acetone, nitrite, and hydroxylamine.

In this discussion it is assumed that nitro-compounds may be reduced to oximes (Dunstan and Dymond, *Proc.*, 1894, 139), and grounds are now stated for concluding that whilst the nitroparaffins themselves may be reduced (in acid solution) to substituted hydroxylamines, their salts, when reduced (in alkaline solution), furnish oximes or their decomposition products. These facts afford further justification for the view that the "salts" of the nitroparaffins are derivatives of a tautomeride containing the group  ${:}\underset{\underset{O}{\|}}{N}\cdot OH$.

*133. "Hexachlorides of benzonitrile, benzamide and benzoic acid."
By Francis Edward Matthews.

Benzonitrile mixed with water is saturated with chlorine and exposed to light till the yellow colour of the chlorine disappears. This process is repeated four or five times. The mixture is then subjected to steam distillation till all the benzonitrile has passed over. A thick oil remains which, on purification by solution in, and subsequent recrystallisation from, glacial acetic acid, gives colourless crystals of benzonitrile hexachloride, $C_6H_5Cl_6 \cdot CN$, melting at 157°.

The hexachloride is not easily hydrolysed, but heating with strong sulphuric acid at 170—180° converts it into the hexachloride of benzamide.

This, crystallised from acetic acid, melts at 187—188°.

On treating the hexachloride of benzamide with fuming nitric acid, the following change takes place: $C_6H_5Cl_6 \cdot CONH_2 + HNO_3 = C_6H_5Cl_6 \cdot CO_2H + N_2O + H_2O$.

The hexachloride of benzoic acid has been obtained pure and has been analysed.

Its most striking property is the decomposition it undergoes on boiling with water, thus: $C_6H_5Cl_6 \cdot CO_2H = C_6H_5Cl_5 + HCl + CO_2$.

The benzoic acid hexachloride and the monochlorobenzenetetrachloride are being further investigated.

*134. "The influence of solvents on the rotation of optically active compounds. I." By T. S. Patterson.

Experiments to determine the influence of some solvents on the rotation of ethyl tartrate at various concentrations and temperatures were described. From the data obtained it is possible to deduce the rotation in each of the solvents dealt with, at any temperature within the limits of the experiments and at any concentration whatever, with fair accuracy.

The results obtained may be summarised thus:

1. *Water.*—Ethyl tartrate in dilute aqueous solution has a much higher specific rotation than in the pure state. In solutions weaker than 55 per cent. the rotation diminishes with increase of temperature.

2. *Methyl Alcohol.*—In dilute solution in methyl alcohol the specific rotation of ethyl tartrate is considerably higher than in the pure state.

In all solutions the specific rotation increases with increase of temperature, and at much the same rate as that of the pure ester.

3. *Ethyl Alcohol.*—Dilute solutions of ethyl tartrate in ethyl alcohol have a specific rotation slightly higher than that of the pure ester.

A maximum value of the specific rotation only seems to be reached at infinite dilution.

Increase of temperature causes increase of rotation in all solutions, the rate of variation being much the same as in the pure ester.

4. *Propyl Alcohol.*—No mixture of ethyl tartrate and propyl alcohol seems to have a higher specific rotation than pure ethyl tartrate at temperatures below 30°. At higher temperatures this is not the case.

The specific rotation in all solutions increases with increase of temperature, the rate of increase being generally slightly greater than in the pure ester.

5. *Glycerine.*—Dilute solutions of ethyl tartrate in glycerine have a considerably higher specific rotation at low temperatures than the pure ester, but as in the case of ethyl alcohol, the maximum rotation appears to be reached only at infinite dilution.

The influence of increase of temperature is in all cases to increase the rotation, the rate of increase being in dilute solutions less and in concentrated solutions greater than for the pure ester.

The data obtained were then discussed in order to trace, if possible, the variation in rotation of the dissolved ethyl tartrate to some known property of the solvent. It was suggested that the property known as internal pressure possesses the necessary qualifications, and investigation seems to justify its choice. Since the data obtained render the calculation of molecular solution volume possible, this was first compared with the rotation, and it was shown that a regularity can be established, and that the variation of rotation with change of temperature may be explained by certain assumptions regarding the variation of the asymmetry of a molecule with the variation of its volume.

These phenomena of rotation were then traced back a step further to internal pressure, or what is probably the same thing—heat of disgregation, when very similar regularities are observed, which seems to show that the original assumptions, regarding the dependence of solution volume on internal pressure and of rotation on both, are justified.

*135. "The action of heat on ethyl sulphuric acid." By William Ramsay and G. Rudorf.

Ethyl hydrogen sulphate, when heated, yields as gaseous products of decomposition, sulphur dioxide, carbon dioxide and monoxide, and ethylene. The oxides of carbon, after the reaction has fairly started, are present in approximately equivalent proportions ; this seems to point to the oxidation of the alcohol to oxalic acid, which is at once decomposed by the sulphuric acid. But glycol, heated with sulphuric acid, yields no carbon monoxide, hence this explanation is of questionable validity. When ethylene is bubbled through hot sulphuric acid, the products are the same in kind, and approximately the same in relative amount, as when hydrogen ethyl sulphate is heated. It was proved, in conclusion, that even at 250° carbon monoxide does not deprive sulphuric acid of oxygen ; hence the formation of carbon dioxide in the preceding experiments cannot be attributed to the oxidation of carbon monoxide ; it must have been a direct product of the reaction.

*136. "Contributions to the knowledge of fluorescent substances. I. The nitro-derivatives of fluorescein." By J. T. Hewitt and B. W. Perkins.

Attention has been called to the non-fluorescence of the alkaline salts of tetranitrofluorescein (R. Meyer, *Zeit. phys. Chem.*, 1897, **24**, 468; and Hewitt, *Proc.*, 1900, **16**, 3; and *Zeit. phys. Chem.*, 1900, **34**, 1). This absence of fluorescence might possibly be explained by the existence of such tautomerism between the hydroxyl and nitro-groups as usually occurs with ortho- and para-nitrophenols, which would inhibit the double symmetrical tautomerism which, as one of the authors has previously pointed out, is so characteristic of many fluorescent substances. Under these circumstances it seemed very desirable to subject dinitrofluorescein to a further study, since this substance has only been analysed as a hydrate, $C_{20}H_{12}(NO_2)_2O_6$ (von Baeyer, *Annalen*, 1876, **183**, 32). In order to obtain the true anhydrous dinitrofluorescein, its diacetyl derivative, which may be prepared by the action of acetic anhydride on the hydrate, was hydrolysed with fairly concentrated sulphuric acid (80 per cent.). The anhydrous compound thus obtained dissolves in cold dilute soda solution with an orange-brown colour and with no trace of fluorescence. On warming, the solution readily goes blue, a salt of the hydrate being produced.

To determine the position of the nitro-groups in dinitrofluorescein, potash fusion was resorted to, and a small quantity of a substance of m. p. 114° (uncorr.) obtained. Nitroresorcinol ($OH:OH:NO_2 = 1:3:4$) melts at 115°.

Tetranitrofluorescein has also been examined, but the authors have been unable to obtain von Baeyer's numbers on analysis, the results always pointing to the formula $C_{20}H_{10}(NO_2)_4O_6$. Hence arguments deduced from the non-fluorescence of alkaline salts of this compound have no bearing on the question as to whether a pyrone ring is a "fluorophor" as the pyrone ring does not exist in the compound. Hence the results obtained with regard to the non-fluorescence of the alkaline solutions of dinitrofluorescein are especially significant, since in this compound the pyrone ring may be preserved intact and the fluorescence inhibited by the nitro-groups alone.

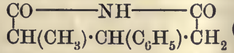
137. "Derivatives of ethyl α-methyl-β-phenylcyanglutarate." By W. Carter and W. Trevor Lawrence.

When ethyl cinnamate and ethyl sodiocyanacetate are allowed to interact in alcoholic solution, methyl iodide being subsequently added to the condensation product, it is found that the neutral reaction mixture consists almost entirely of equal quantities of the two stereoisomeric forms of ethyl α-methyl-β-phenyl-α-cyanglutarate, $C(CO_2Et)(CH_3)(CN){\cdot}CH(C_6H_5){\cdot}CH_2(CO_2Et)$.

The α-modification is a crystalline solid, crystallising from ligroin in prisms which melt at 89°, the β-modification is a liquid boiling at 260° (100 mm.); both isomerides, on addition of alcoholic potash, are converted into microcrystalline potassium salts, which separate completely from the mother liquor.

From these potassium salts two distinct acids are obtained. The α-acid is fairly soluble in water, from which it separates slowly in prisms, melting with decomposition at 161°; the β-acid is much less soluble in water and melts at 194°.

Both acids are converted by hydrochloric acid into methyl-phenyl-glutarimide,



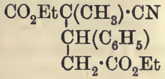
$$\begin{array}{l}CO\text{———}NH\text{———}CO\\ CH(CH_3){\cdot}CH(C_6H_5){\cdot}CH_2\end{array}$$

(prisms from water, m. p. 144°), and are completely hydrolysed by sulphuric acid with formation of methyl-phenyl-glutaric acid; on prolonged boiling with aqueous potash, they are converted into α-methyl-β-phenyl-αα-γ-propanetricarboxylic acid, $C(CO_2H)_2(CH_3){\cdot}CH(C_6H_5){\cdot}CH_2(CO_2{\cdot}H)$, which crystallises from a mixture of chloroform and acetone, and melts, with decomposition, at 148°.

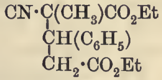
Acetyl chloride offers a means of differentiating between the two modifications, as it converts the α-acid into a substance melting at 110°, which possesses acid properties, and is easily decomposed by water, whereas the β-acid forms a neutral substance melting at 146°, which is fairly stable towards water. The following formulæ have been assigned to the α- and β-esters, acids, and acetyl derivatives:

α-. β-.

Esters

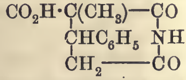


$$\begin{array}{l}CO_2EtC(CH_3){\cdot}CN\\ \quad CH(C_6H_5)\\ \quad CH_2{\cdot}CO_2Et\end{array}$$



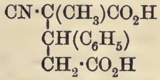
$$\begin{array}{l}CN{\cdot}C(CH_3)CO_2Et\\ \quad CH(C_6H_5)\\ \quad CH_2{\cdot}CO_2Et\end{array}$$

Acids



$$\begin{array}{l}CO_2H{\cdot}C(CH_3)\text{—}CO\\ \quad CHC_6H_5\quad NH\\ \quad CH_2\text{———}CO\end{array}$$

Methylphenylglutarimide-α-carboxylic acid.

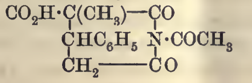


$$\begin{array}{l}CN{\cdot}C(CH_3)CO_2H\\ \quad CH(C_6H_5)\\ \quad CH_2{\cdot}CO_2H\end{array}$$

Methylphenyl-α-cyanglutaric acid.

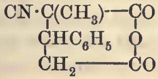
Substances produced by action of acetyl chloride.

Methylphenyl *n*-acetylglutarimide-α-carboxylic acid.



$$\begin{array}{l}CO_2H{\cdot}C(CH_3)\text{—}CO\\ \quad CHC_6H_5\quad N{\cdot}COCH_3\\ \quad CH_2\text{———}CO\end{array}$$

Methylphenyl-α-cyanglutaric anhydride.



$$\begin{array}{l}CN{\cdot}C(CH_3)\text{—}CO\\ \quad CHC_6H_5\quad O\\ \quad CH_2\text{———}CO\end{array}$$

By this reaction methylphenylglutaric acid, previously obtained with great difficulty (Avery and Fossler, *Am. Chem. J.*, 1899, **20**, 516), may be easily prepared.

α-Methyl-β-phenylglutaric acid, $CH(CH_3)(CO_2H){\cdot}CH(C_6H_5){\cdot}CH_2(CO_2H)$ crystallises from water or ligroin in prisms (m. p. 125°); theoretically, the acid should exist in two modifications, but up to the present time the authors have only isolated one form, which, from its easy conversion into the anhydride, is probably the *cis*-modification.

Acetyl chloride converts the acid into a double anhydride with acetic acid, which crystallises from benzene in asbestos-like masses, melting at 107°; its formula is $[C(CO{\cdot}O{\cdot}COCH_3)H(CH_3){\cdot}CHC_6H_5{\cdot}CH_2{\cdot}CO]_2O$. When this is distilled, the true anhydride of methylphenylglutaric acid is obtained as a gum which slowly solidifies to a solid mass melting at 74°; the corresponding anilic acid is also a gum.

Methylphenylglutaric acid is unacted upon by boiling permanganate solution; boiling with fuming nitric acid converts it into two nitro-derivatives, of which the less soluble melts at 208° and the more soluble at 179°; both substances possess the formula $C_{12}H_{13}O_4{\cdot}NO_2$, and are probably *o*- and *p*-nitrophenylmethylglutaric acid.

138. "The nitration of acetamino-orthophenyl acetate (diacetylorthoaminophenol). A correction." By Raphael Meldola, F.R.S., and Elkan Wechsler.

The object of this note is to correct and extend the statement (Meldola, Woolcott, and Wray, *Trans.*, 1896, **69**, 1325) that the nitration of acetamino-orthophenol acetate under the conditions specified gave a mononitro-derivative, which, on further nitration, gave a dinitro-derivative. A repetition of this work has led to the conclusion that a dinitro-derivative is produced under all conditions of nitration. The statement in the paper above referred to was based on an error of analysis. The dinitro-derivative crystallises from hot water in long, ochreous needles melting at 201°, and softening at a temperature some degrees lower.

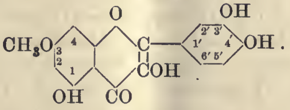
Two experiments gave $N = 17{\cdot}30$ and $17{\cdot}39$ per cent. respectively. $C_6H_2(NO_2)_2{\cdot}NHAc{\cdot}OH$ requires $N = 17{\cdot}42$ per cent.

One acetyl group is split off during nitration. The dinitro-derivative is readily hydrolysed by boiling for a short time with sodium hydroxide solution, and the dinitro-aminophenol thus obtained proved to be *picramic acid* as shown by the melting point (167—168°), by conversion, by the diazo-method, into 2-chloro-4 : 6-dinitrophenol of m. p. 110—111°, and by a comparison of the properties of the diazoxide with the description of this compound given by Griess (*Annalen*, **113**, 205).

The nitration of diacetyl orthoaminophenol thus gives rise to the direct formation of 2-acetamino-4 : 6-dinitrophenol, and the formulæ given in that section of the previous paper must be revised accordingly.

139. "Rhamnazin and rhamnetin." By A. G. Perkin and J. R. Allison.

In rhamnazin (quercetin dimethyl ether), the position of but one methoxyl group is known (*Trans.*, 1897, **71**, 818), whereas that in rhamnetin (quercetin monomethyl ether) (Herzig, *Monatsh.*, 1888, **9**, 548) has not been determined with certainty. On gentle decomposition, rhamnazin, rhamnetin and quercetin tetramethyl ether give the same phloroglucinol derivative, as in each case the latter reacts with diazobenzene to form a compound, occurring in orange-red needles, m. p. 251—252°. This is *diazobenzenephloroglucinol monomethylether.* (Found C = 65·17 ; H = 4·64 ; N = 15·57 ; CH_3 = 4·40 per cent.) ; consequently rhamnazin is methoxyrhamnetin, and both contain a methoxyl group in the (3) position.



Rhamnetin.

140. "Luteolin. III." By A. G. Perkin and L. H. Horsfall.

On methylation, luteolin (from weld) yields two ethers insoluble in alkali, (*a*), m. p. 191—192° (*Trans.*, 1896, **69**, 206) and a more soluble compound (*b*), newly isolated, m. p. 161—163°. The latter, $C_{15}H_7O_3(OCH_3)_3$, is the true *luteolin trimethyl ether*, for on decomposition it forms *veratric acid* and *phloroglucinol monomethyl ether* (identified as its diazobenzene derivative, m. p. 251—252°). The ether (*a*), m. p. 191—192°, appears to be *methylluteolin trimethyl ether*, due to the existence of a methyl group entering the ring during methylation, or less probably to the presence of methylluteolin in weld. On gentle decomposition, *veratric acid*, and a crystalline phloroglucinol derivative result, the latter yielding, with diazobenzene, a derivative, in orange-coloured needles, m. p. 198—200°, $C_8H_8O_7(C_6H_5N_2)_2$, apparently *diazobenzenemethyl phloroglucinol monomethyl ether. Acetyl methylluteolin,* colourless needles, melts when rapidly heated at 238—240°. Luteolin from the *Genista tinctoria* behaves similarly on methylation. The monopotassium and sodium salts of luteolin have now been crystallised, and have the respective compositions $KC_{15}H_9O_6$ and $NaC_{30}H_{19}O_{12}$. Weld contains a trace of another colouring matter, $C_{15}H_{10}O_5$, which, on decomposition with alkali, yielded p-*hydroxybenzoic acid*, a trace of protocatechuic acid, *phloroglucinol*, and p-*hydroxyacetophenone.* By further reactions, it was identified as *apigenin.* By the gentle action of alkali, morin, a colouring matter of *Morus tinctoria*, yields, in addition to β-resorcylic acid and phloroglucinol (*Trans.*, 1896, **69**, 697), previously found, some quantity of *β-resorcylic aldehyde.*

141. "Genistein. II." By A. G. Perkin and L. H. Horsfall.

Genistein dimethyl ether m.p. 137—139° (*Trans.*, 1899, **75**, 835) yields a monacetyl derivative m.p. 202—204°, $C_{14}H_7O_2(OCH_3)_2C_2H_3O$, and on gentle decomposition gives p-*methoxyphenylacetic acid* and *phloroglucinolmonomethyl ether*, identified as its diazobenzene derivative m.p. 251—252°. The second product of the methylation, m.p. 200—202° (previously given as 187—189°), appears to be a *methylgenistein dimethyl ether* (compare luteolin). It forms a monacetyl derivative, $C_{17}H_{15}O_5 \cdot C_2H_3O$, m.p. 212—214°, and on decomposition gives *methoxyphenylacetic acid* and a phloroglucinol derivative whose diazobenzene compound (probably *diazobenzene methylphloroglucinolmonomethyl ether*), orange-coloured needles, melts at 198—200°. This is identical with that produced from methylluteolintrimethyl ether. *Genistein diethyl ether*, $C_{14}H_8O_3(OEt)_2$, colourless needles, m.p. 132—134°, and its monacetyl derivative, m.p. 168—170°, have been obtained. On decomposition it gives p-*ethoxyphenylacetic acid* and a phloroglucinol compound. These results are in harmony with the constitution of a *trihydroxyphenylketocumaran* previously suggested (*loc. cit.*) for genistein. Genistein from *Genista tinctoria* melts at 291—293°.

142. "The colouring matter of the flowers of *Delphinium consolida*." By A. G. Perkin and E. J. Wilkinson.

The presence of a yellow colouring matter in these flowers (in the form of glucoside) has been previously notified (*Trans.*, 1898, **73**, 275). This compound forms yellow needles, has the composition $C_{15}H_{10}O_6$ (found C = 62·85 ; H = 3·63 per cent.), and on fusion with alkali gives phloroglucinol and *p*-hydroxybenzoic acid (found C = 60·71 ; H = 3·94). The *tetracetyl* compound, $C_{15}H_6O_6(C_2H_3O)_4$ (found C = 60·64 ; H = 4·17), is peculiar, for when crystallised from alcohol it melts at about 114—116°, resolidifies at a higher temperature, and again melts at 181—183°. This is not due to alcohol of crystallisation. The *sulphate*, $C_{15}H_{10}O_6,H_2SO_4$, orange-red needles (found C = 46·71 ; H = 3·39), the *hydriodide*, $C_{15}H_{10}O_6HI$ (found

$C = 44{\cdot}25$; $H = 3{\cdot}00$), and the *monopotassium* salt, $C_{15}H_9O_6K$ (found $K = 11{\cdot}85$), have been obtained, but are less stable than is usually the case with such compounds. The colouring matter has properties resembling those assigned to kampherol (Gordin, *Diss. Berne*, 1897), obtained by the decomposition of its methyl ether, kampherid, which exists in galanga root (*Alpinia officinarum*). The investigation will be continued with the hope of ascertaining the identity of this colouring matter with certainty.

143. "Note on Gallinek's amidomethylnaphthimidazole." By Raphael Meldola, F.R.S., and Frederick William Streatfeild.

A paper by Gallinek has just been published (*Ber.*, 1900, **33**, 2315) on a sulphonic acid of the anhydro-base obtained by reducing dinitro-α-acetnaphthalide. Gallinek assumes that the base he has been dealing with is the same as that described by the authors (*Trans.*, 1887, **51**, 691), and he considers that their failure to separate the base in the free state was due to their having had impure dinitro-α-acetnaphthalide as their raw material. The authors desire now to point out that Gallinek is completely in error in his original assumption, and that the base described by him is isomeric, and not identical with that described by the authors in 1887. Gallinek does not state what reducing agent he employed, nor does he refer to the process published by Markfeldt (*Ber.*, 1898, **31**, 1174), but his description of the base as being stable, solid and crystallisable from water renders it tolerably certain that he has been investigating Markfeldt's base. Markfeldt also assumed that his base was identical with that described by the authors in 1887. The isomerism was recently made known and the properties of the base obtained by Markfeldt's process somewhat fully characterised (Meldola and Eynon, *Trans.*, 1900, **77**, 1159). The authors think it necessary to indicate the true cause of the apparent discrepancy between the statements of the German investigators and themselves, because they are at present engaged in the further investigation of the nature of the isomerism.

144. "The amount of chlorine in rain water collected at Cirencester." By Edward Kinch.

The author has already published the results (*Trans.*, 1887, **51**, 92) of the estimation of the chlorine in the water collected in a rain gauge at the Royal Agricultural College, 443 feet above sea level, and about 35 miles distant from the sea. The results of his determinations up to the present time are summarised below.

The rain water for periods of six months, namely, summer months, April to September, and winter months, October to March, inclusive, gave the following averages :

Periods.	Rainfall in inches.	Chlorine per million.	Equivalent to NaCl, grams per gallon.	Equivalent to NaCl, lbs. per acre.
Mean of 14 winter periods to March, 1900	14·26	3·55	0·412	19·35
Mean of 14 summer periods to September, 1900	12·78	2·27	0·261	10·40
Average of 14 years to September, 1900	27·04	2·91	0·337	29·75
Mean of 26 winter periods to March, 1900	15·83	3·76	0·435	21·29
Mean of 26 summer periods to September, 1900	14·78	2·58	0·302	14·81
Average of 26 years to September 31st, 1900	30·61	3·17	0·369	36·10

145. "Researches on the alkyl-substituted succinic acids. III. Dissociation constants." By W. A. Bone and C. H. G. Sprankling.

The authors have prepared, and determined the dissociation constants of, a number of new alkyl-substituted succinic acids as follows :

		M. p.	*K.*
sym-Di-*iso*butylsuccinic	*trans-*	195°	0·0225
	cis- ...	97— 98	0·056
$\alpha\alpha_1$-Methylpropylsuccinic	*trans-*	158—160	0·0355
	cis- ...	92— 93	0·0271
$\alpha\alpha_1$-Methyl*iso*butylsuccinic	*trans-*	133	0·0427
	cis- ...	88— 90	0·0236
$\alpha\alpha_1$-Methyl*iso*amylsuccinic......	*trans-*	141—142	0·0236
	cis- ...	93	0·0385
$\alpha\alpha$-Dimethyl-α_1-ethylsuccinic		139—140	0·0566
$\alpha\alpha$-Dimethyl-α_1-propylsuccinic..................................		145	0·060
$\alpha\alpha$-Dimethyl-α_1-*iso*propylsuccinic		141—142	0·0158
$\alpha\alpha$-Dimethyl-α_1-*iso*butylsuccinic..............................		143—144	0·0432
$\alpha\alpha$-Dimethyl-α_1-*iso*amylsuccinic..............................		143—144	0·0616

They then discuss, in the light of the above and previous results, the effect of alkyl-substitution on the magnitude of the dissociation constant of a succinic acid, and deduce the following conclusions.

Each alkyl group exerts its own influence upon the constant dependent on its mass and structure. In the case of *normal* radicles, where the influence of 'mass' only is to be traced, an increase in the mass of the alkyl is invariably accompanied by a corresponding rise in the constant. In the case of 'iso'-radicles, there is, however, a 'structural' effect opposed to that of mass, except in the case of the *cis*-aa_1-substituted acids, which are separately discussed; the magnitude of this structural effect is always dependent on the proximity of the 'iso'-linkage to the carbon atom to which the carboxyl group is attached.

146. "The reaction between ethyl alcohol and hydrochloric acid."

By T. Slater Price, D.Sc.

The present investigation was undertaken in order to measure the velocity of reaction between hydrochloric acid and ethyl alcohol. On redetermining the equilibrium constants it was found that they varied with the amount of acid used. (The constants (α) were calculated according to the equation $\alpha = (A - x)(B - x)/(C + x)(D + x)$ where A, B, C, and D are the concentrations of the alcohol, acid, water and ester respectively at the commencement of the reaction, and x the amount of fresh ester formed when equilibrium is reached.) The results obtained agree with those of Zaitschek (*Zeit. phys. Chem.*, 1897, 24, 1), who investigated the action of sulphuric acid on alcohol.

Determinations were made at 77°, 99° and 129·5°. The value of α decreases as the amount of acid increases; this is well shown especially in the experiments at 77°, as the lower the temperature the greater is the variation.

The results obtained by the author are found to agree very well with the equation $dx/d\theta = k_1(A - x)(B - x)^2 - k_2(C + x)(D + x)(B - x)$, where k_1 and k_2 are the velocity constants of the direct and reverse reactions, x is the amount of ester formed after the time θ, and A, B, C, and D have the signification given above. The catalytic effect of the hydrogen ions is assumed to be proportional to the amount $(B - x)$ of acid present, this holding good over a short interval of time, and since both the direct and reverse reactions are affected the factor $(B - x)$ will be extra in each term of the velocity equation. The values of k_1 so obtained are especially good when no water is present to begin with, that is, when $C = O$ (in no case was ester present at the commencement of the reaction), but when the reaction mixture used contained water to start with, the values of k_1 diminish as θ increases.

The value of k_1 decreases as the concentration of the acid increases, and is also greatly diminished when water is present.

The velocity of reaction increases very rapidly with the temperature, the increase being much greater than in the case of the action of organic acids on alcohol.

ADDITIONS TO THE LIBRARY.

I. Donations.

Bartley, D. C. Adulteration of Food. Statutes and cases dealing with coffee, tea, bread, seeds, food and drugs, margarine, fertilisers and feeding stuffs, &c., including the Food and Drugs Act, 1899. Second edition. London 1899.

Clowes, Frank, and Coleman, J. B. Quantitative chemical analysis. Fifth edition. London 1900. From the Authors.

Duparc, L., Degrange, E., et Monnier, A. Traité de chimie analytique qualitative suivi de Tables systématiques pour l'analyse minérale. Genève et Paris 1900. From Messrs. Sampson, Low and Co.

Letts, E. A., and Blake, R. F. The carbonic anhydride of the atmosphere. (Reprinted from the *Proceedings* of the Royal Dublin Society). Dublin 1900. From the Authors.

Mitchell, C. Ainsworth. Flesh foods, with methods for their chemical, microscopical, and bacteriological examination. London 1900. From the Author.

Roos, L. Wine-making in hot climates. Translated by R. Dubois and W. P. Wilkinson. Melbourne 1900. From the Translators.

Sutton, Francis. A systematic handbook of volumetric analysis. Eighth edition. London 1900. From the Author.

Gerhardt, Charles, sa vie, son œuvre, sa correspondance 1816–1856. Document d'histoire de la chimie, par Edouard Grimaux et Charles Gerhardt. Paris 1900. From the Authors.

Bedford, the Duke of, and Pickering, S. U. Second report on the working and results of the Woburn Experimental Fruit Farm. London 1900. From the Authors.

At the next meeting, on Thursday, November 15th, the following paper will be communicated.

"The bases contained in Scottish shale oil." By F. C. Garrett, M.Sc., and J. A. Smythe, B.Sc., Ph.D.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 228.

November 15th, 1900. Professor THORPE, C.B., F.R.S., President, in the Chair.

Messrs. F. C. Britten, G. C. Thomson, R. G. Halstead, and J. A. Mathews were formally admitted Fellows of the Society.

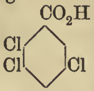
The following certificates were read for the first time:—Messrs. H. H. Cousins, Government Laboratories, Kingston, Jamaica; Robert Dodd, 28, Sibella Road, Clapham, S.W.; Arthur Houldershaw, 71, Lavender Gardens, West Jesmond, Newcastle-on-Tyne; Edward Hughes, Rectory, Barmouth; Robert Salmon Hutton, Owens College, Manchester; Stephen Archigenes Ionides, Balliol College, Oxford; Robert Henry Jones, Glen Albyn, Coity Road, Bridgend, Glam.; H. T. G. van der Linde, 101, Tyndall Avenue, Toronto, Canada; William Meredith, 63, Albion Place, Ulverston; James Moir, The Ash, 62, Hamilton Place, Aberdeen, Scotland; H. M. Smith, 79, Helix Road, Brixton, S.W.

Of the following papers, those marked * were read:—

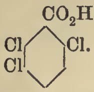
*147. "Trichlorobenzoic acid." By Francis Edward Matthews.

The hexachloride of benzonitrile is acted upon by alcoholic sodium hydroxide, forming a mixture of trichlorobenzoic acids, which, on fractional crystallisation of the barium salts, was found to give a new trichlorobenzoic acid.

At present four of the six possible trichlorobenzoic acids are known, the missing two being



and



As the new acid was found to yield an ester readily when treated with hydrogen chloride and alcohol, which an acid having the second of the above formulæ should not do, both positions adjacent to the carboxyl group being occupied by chlorine, the former of the two formulæ may be taken as proved.

By the action of quinoline upon the nitrile, $C_6H_5Cl_6\cdot CN$, followed by steam distillation, the nitrile of the new acid, $C_6H_2Cl_3\cdot CN$, is easily prepared in a state of purity. It crystallises from aqueous alcohol in long, white, lustrous needles melting at 87°. After hydrolysis with alcoholic sodium hydroxide, the acid, which crystallises from water in small needles melting at 163°, is readily obtained.

The following salts have been prepared: $(C_6H_2Cl_3CO_2)_2Ba + 3H_2O$; $(C_6H_2Cl_3\cdot CO_2)_2Sr + 3H_2O$; $(C_6H_2Cl_3\cdot CO_2)_2Ca + 4H_2O$; $C_6H_2Cl_3\cdot CO_2Ag$. The acid chloride, $C_6H_2Cl_3\cdot COCl$, melts at 36°; the amide, $C_6H_2Cl_3\cdot CONH_2$, crystallises in small needles which melt at 204—205°.

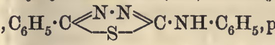
The ethyl ester, $C_6H_2Cl_3\cdot CO_2Et$, is obtained by the action of hydrogen chloride and alcohol upon the acid. It is a liquid volatile with steam and possessing, but in a lesser degree, the odour of ethyl benzoate.

*148. "Oxidation of benzalthiosemicarbazone." By George Young, Ph.D., and William Eyre, B.Sc.

Benzal thiosemicarbazone, $C_6H_5\cdot CH{:}N\cdot N{:}C(SH)\cdot NH_2$, is oxidised by ferric chloride to *amidophenylthiodiazole*, $C_6H_5\cdot C{<}\substack{N\cdot N\\ S}{>}C\cdot NH_2$. The base melts at 222—223°, its hydrochloride at 213—214°. The methyl derivative, $C_6H_5\cdot C_2N_2S\cdot CH_3{:}NH$, is an oil; its platinichloride, $[C_9H_9N_3S]_2H_2PtCl_6$, melts at 218°. The acetyl derivative, $C_6H_5\cdot C_2N_2SNH\cdot COCH_3$, which melts at 276°, is an acid forming stable sodium and silver salts. Both the methyl and acetyl derivatives yield the same methylacetyl derivative, $C_6H_5\cdot C_2N_2SCH_3{:}N\cdot COCH_3$, which melts at 144°.

Benzal-4-methylthiosemicarbazone, $C_6H_5\cdot CH{:}N\cdot N{:}C(SH)\cdot NH\cdot CH_3$, is similarly oxidised to $C_6H_5\cdot C{<}\substack{N\cdot N\\ S}{>}C\cdot NH\cdot CH_3$, *methylamidophenylthiodiazole*, which melts at 183—184°. Its platinichloride, $[C_9H_9N_3S]_2H_2PtCl_6$, melts at 208—209°. The acetyl derivative, $C_6H_5\cdot C_2N_2S\cdot N{<}\substack{CH_3\\ COCH_3}$, melts at 195°.

Benzal-4-phenylthiosemicarbazone, $C_6H_5{\cdot}CH{:}N{\cdot}N{:}C(5H){\cdot}NH{\cdot}C_6H_5$, yields phenylamidophenylthiodiazole,



$C_6H_5{\cdot}C{<}\overset{N\cdot N}{\underset{S}{}}{>}C{\cdot}NH{\cdot}C_6H_5$, previously described by Marckwald. Its silver derivative, $C_{14}H_{10}N_3SAg$, decomposes with explosive violence when suddenly heated.

*149. "The nitration of benzeneazosalicylic acid." By J. T. Hewitt and J. J. Fox.

One of the authors has already pointed out (Hewitt, *Trans.*, 1900, **77**, 99) that when dilute nitric acid is warmed with benzeneazophenol a substance results in which the nitro-group has entered the phenol nucleus in the ortho-position relatively to the hydroxyl. Noelting, on the other hand, by nitrating benzeneazophenol in strong sulphuric acid obtained paranitrobenzeneazophenol (*Ber.*, 1887, **20**, 2997).

The authors have studied the action of nitric acid on benzeneazosalicylic acid under varying conditions and find that with dilute acid at 65—70° the nitro-group enters the salicylic acid residue in the ortho-position relatively to the hydroxyl. The constitution of the resulting compound was determined by comparison with the product obtained from phenyldiazonium chloride and nitrosalicylic acid ($CO_2H : OH : NO_2 = 1 : 2 : 3$).

Benzeneazoorthonitrosalicylic acid melts at 197° (uncorr.), its *methyl ester* at 132—134° and the *ethyl ester* at 128—129°.

By the nitration of benzeneazosalicylic acid dissolved in concentrated sulphuric acid paranitrobenzeneazosalicylic acid, identical with the substance described by Meldola (*Trans.*, 1885, **47**, 666), was obtained. Its ethyl ester melts at 220—225°.

*150. "Upon the collection and examination of the gases produced by bacteria from certain media." By Walter C. C. Pakes and Walter H. Jollyman.

The authors described a new apparatus for the collection of the gases produced by bacteria when grown either under ærobic or anærobic conditions.

Experimenting with the *Bacillus pyocyaneus*, which is supposed to be a strictly ærobic organism, they found that it grew in media containing 1 per cent. of potassium or ammonium nitrate under the strictest anærobic conditions as the term is at present understood (that is, in the presence of hydrogen, or in the absence of any gas). They concluded, therefore, that the terms ærobic and anærobic must be extended to include the presence of oxygen in the form of nitrates.

Upon analysing the gases produced by this organism from media containing nitrates, they found that both free oxygen and free nitrogen were evolved, the former in small quantities but constantly.

151. "The bases contained in Scottish shale oil." By Frederic Charles Garrett, M.Sc., and John Armstrong Smythe, B.Sc., Ph.D.

Though many investigators have examined the bases contained in coal tar, but little attention has been paid to those present in shale oil, the authors have therefore undertaken the examination of those obtained from the Broxburn oil. The shale, on distillation, yields gas, ammonia water and "crude oil"; this "crude oil" is again distilled, giving "green naphtha," "green oil" and "still coke," the temperature towards the end of the operation rising to a red heat. A quantity of this "green naphtha" was washed with ¼ per cent. of sulphuric acid (diluted to about 15 per cent.). Steam was blown through the reddish-brown liquid so obtained for several hours to free it from a small quantity (about 0·1 per cent.) of an oily liquid possessing a peculiarly disgusting smell; when this had been removed sodium hydroxide solution (17½ per cent.) was added and superheated steam blown through until all the volatile bases had been driven over. The soluble bases in the distillate were thrown out by the addition of solid sodium hydroxide, the mixed bases were then dried by solid potash and fractionally distilled; each litre of the crude acid liquor yields about 120 grams of the dry bases, of which about 25 per cent. boil below 170°, and 46 per cent. between 170° and 205°.

The basic oil thus obtained was then repeatedly refractionated, and an attempt made to isolate the various bases in the lower fractions by precipitation with mercuric chloride and fractional crystallisation of the salts so obtained. The portion boiling below 125° (about 10 grams) was examined for pyridine by precipitation with potassium ferrocyanide but none was found, the base being chiefly α-picoline (b. p. 128°); from the other fractions below 160°, the symmetrical collidine ($\alpha\gamma\alpha'$-trimethyl pyridine) and two other bases which appear to be the hitherto undescribed lutidines ($\alpha\beta$- and $\alpha\beta'$-dimethyl pyridine). The first of these boils at about 160° and yields a platinichloride melting with decomposition at 208°, whilst the second boils at about 140°, and although no platinum compound was isolated it yielded a gold compound melting at 73°; in each case, however, the amount of base obtained was very small. Having now obtained between two and three kilograms of the raw bases, the authors are attempting a more systematic examination of them.

The authors have to thank Mr. George Beilby for calling their attention to the necessity for this work, and Mr. D. R. Steuart for kindly providing them with the raw material they required.

152. "On a simplified method for the spectrographic analysis of minerals." By Walter Noel Hartley, F.R.S., and Hugh Ramage, A.R.C.Sc.I.

The authors pointed out that some of the rare earths are very difficult to detect and others more widely diffused are not easily separated and recognised either by the ordinary methods of chemical analysis or by spectroscopic examination. A simplification of the method of obtaining oxyhydrogen blow-pipe spectra (Hartley, *Phil. Trans.*, 1894, **185**, 168) was described and examples given of its application to the analysis of various metallurgical products, metallic ores, and siliceous minerals. The method is to burn the metals, minerals, or precipitates on ashless filter papers in an oxyhydrogen flame and to photograph the spectra in the usual way. Refractory silicates in very fine powder are decomposed by being heated with strong sulphuric acid and ammonium fluoride which has been purified by distillation in a platinum retort. After the complete decomposition of the mineral the sparingly soluble sulphates are separated by filtration and burnt on the ashless paper. The hydroxides of the heavy metals are precipitated by ammonia and similarly burnt. The alkalis are contained in the aqueous solution of which the treatment is varied according to the nature of the substance under examination. For the separation of rubidium and cæsium, platinic chloride is used and the platinichlorides collected and burnt.

ADDITIONS TO THE LIBRARY.

By Purchase.

Cohnheim, Otto. Chemie der Eiweisskörper. Braunschweig 1900.

Migula, W. System der Bakterien. Handbuch der Morphologie, Entwickelungsgeschichte und Systematik der Bakterien. Vol. I. Allgemeiner Teil. Vol. II. Specialle Systematik der Bakterien. Ill. Jena 1900.

Minet, Adolphe. Traité théorique et pratique d'électro-chimie. Ill. Paris 1900.

Pictet, Amé. Die Pflanzenalkaloïde und ihre chemische Konstitution. Second German edition by Richard Wolffenstein. Berlin 1900.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 6th, 1900.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

Bennett, George Lowe,

13, St. Domingo Vale, Everton, Liverpool.

Clerk in Holy Orders. Student of Chemistry, Oxford University, for over three years. Graduated from St. John's College in the Honours School of Chemistry, 1898. Was Casberd Exhibitioner in Chemistry (St. John's College, 1896). Have been Lecturer in Chemistry in Organised Science School.

W. W. Fisher. J. E. Marsh.
P. Elford. *V. H. Veley.*
John Watts.

Binks, Frederick Nisbet,

2, Hollywell Terrace, Millbourne Avenue, Drumcondra, Dublin.

Analytical Chemist. Three years' training in the "Young" Laboratories of the Glasgow and West of Scotland Technical College; 10½ years Assistant to Professor Tichborne, Dublin. Lecturer on Theoretical Chemistry to the Pharmaceutical Society of Ireland, and on Practical Chemistry in the Pembroke Technical Schools.

Chr. R. C. Tichborne. Geo. Ritchie.
Edmund J. Mills. *R. R. Tatlock.*
J. Anderson Craw.

Boyes, Herbert James Singleton,

9, Rua Episcopal, São Paulo, Brazil.

Analytical Chemist. I have been a Student in Owens College, Manchester, taking private course in Chemistry for two years, and have been with Dr. Burghardt, Analytical Chemist, 35, Fountain Street, Manchester, eight months. I am now going abroad as an Analytical Chemist

H. B. Dixon. George J. Allen.
J. R. Appleyard. *W. S. Spencer.*
Walter Ratcliffe.

Burnett, Theodore Ridley,
83, Coltart Road, Liverpool.

Analytical Chemist. At present Assistant in the Laboratory of Professor J. Campbell Brown, D.Sc., Analyst for the County of Lancaster, &c. Studied Chemistry as chief subject for degree of B.Sc. (Vict.) at University College, Liverpool, 1894—1898. Studied at the Polytechnikum, Zürich, under Professors Lunge and Treadwell (1898—1900) for the degree of Ph.D., which was taken at Basel University. Thesis for this degree, "Ueber die Bestimmung der Halogene neben einander."

W. Collingwood Williams. J. Campbell Brown.
H. B. Stocks. Charles A. Kohn.
Edwin Dowzard.

Cheeseright, John Henry,
80, Sydney Road, Hornsey, N.

Science Teacher. Honours in Chemistry and Electricity and Qualified Teacher of Chemistry (Science and Art Department). Intermediate Science, London University.

W. Ball. J. W. Shepherd.
Edward Masters. W. M. Bailey.
John J. Pilley.

Comber, Albert Walter,
Rio Marina, I. d'Elba, Italy.

Metallurgical Chemist. Diploma in Chemistry, Finsbury Technical College (1894—1897). Intermediate Exam. of the Institute of Chemistry (1899). I was for one year (1898) assistant to W. A. Shenstone, Esq., F.R.S., of Clifton College. I was for seven months (Jan.—Aug., 1899) with E. Riley, Esq., F.C.S., F.I.C., of London, for whom I have been acting since Aug., 1899, as sole chemist to the Royal Mines of Elba.

Raphael Meldola. Edward Riley.
W. A. Shenstone. Robt. D. Connell.
James E. Ferguson.

Davidson, Alexander, jun.,
1 Almond Bank Terrace, North Merchiston, Edinburgh.

Chemist to J. and G. Cox, Ltd., Gorgie Mills, Edinburgh. Studied chemistry for six years at the Glasgow Technical College. Elected an "Associate of the Glasgow Technical College" in 1898. Elected an "Associate of the Institute of Chemistry" in 1900. Engaged in research work with Prof. G. G. Henderson during session 1898—99 and part of session 1899—1900.

G. G. Henderson. James Robson.
Thomas Gray. Matthew A. Parker.
D. S. Jordan.

Fechtner, Arthur Louis William,
186, Spring Bank, Hull.

Manufacturing and Analytical Chemist. Qualified by examinations of the Pharmaceutical Society of Great Britain; for four years Managing Manufacturing and Analytical Chemist to the English Pharmacy, Cairo, Egypt, and for seven years (and at present) in the above capacity at the above address.

Jas. Baynes. Fras. A. Drake.
Harry Thompson. *Frederic Wm. Richardson.*
S. Hill.

Freeman, Willie Ludford, B.A.,
102, Marlboro'-road, Oxford.

Schoolmaster. Final Honours in the School of Natural Science (Chemistry), Oxford, 1900.

William Odling. J. E. Marsh.
W. W. Fisher. C. H. H. Walker.
V. H. Veley. *P. Elford.*

Gasson, William,
Kimberley, South Africa.

Chemist and Analyst. Studied Chemistry and other Branches of Science connected with Pharmacy and passed examinations of the Pharmaceutical Society of Great Britain. During past ten years as Analytical Chemist and Assayer in Kimberley, South Africa. Well versed in Metallurgical Processes. The Governor of the Colony has recognised my services by granting a special appointment as Analyst. Desirous of being connected with the Society in order to be in touch with those interested in similar pursuits in England.

M. Carteighe. *Edwin Dowzard.*
W. A. H. Naylor. *Edward Davies.*
Peter MacEwan. *Ernest J. Parry.*

Gibbings, George William,
Standard Bank of S. Africa, Ltd., Salisbury, Mashonaland.

Assayer. Studied Chemistry at Exeter Technical College under Mr. Clayden. Hold Science and Art Advanced Certificates. Three years Chemist in Soapworks, Exeter. Assistant Assayer at Standard Bank

Assay Office, Johannesburg. Assistant Assayer at Standard Bank Assay Office, Bulawayo, Rhodesia. At present the Assayer to the Standard Bank, Salisbury, Rhodesia.

L. Ludlow.	Geo. A. Pingstone.
Gerald A. Parker.	Arthur W. Clayden.

W. H. Lewis.

Gibson, John,

Battle Hill, Hexham, Northumberland.

Chemist. Studied analytical Chemistry for three years under Mr. G. F. Merson, F.C.S. Engaged in Chemistry as specially applied to Photographic Processes, and desirous to obtain the Society's Journal.

Fredk. Gilderdale.	*W. A. H. Naylor.*
E. D. Walrond.	*Geo. Bult Francis.*
Frank R. Dudderidge.	*Charles H. Bothamley.*
Geo. F. Merson.	*P. Phillips Bedson.*

Handcock, Walter Augustus,

Southbank, 40, Avenue Road, Highgate, London, N.

Student. Certificated Chemical Student of The City and Guilds Technical College, Finsbury. Educated at University College School. Matriculated Student, London University.

R. Meldola.	F. Southerden.
Gerald T. Moody.	W. A. Davis.

T. M. Lowry.

Hargreaves, William Arthur,

Port Adelaide, South Australia.

Government Analyst and Inspector of Explosives to the Government of South Australia. Government Analyst under Food and Drugs Act, Fertilisers Act, and other Acts. Analyst to H.M, Customs, and to the Marine Board of South Australia. Formerly First Assistant Government Analyst in the Colony of Queensland, also Lecturer on Chemistry to the College of Pharmacy, Queensland. Is Master of Arts and Bachelor of Civil Engineering of the University of Melbourne, where he graduated first in the first class at the final honour examinations in the School of Natural Science.

J. C. Brünnich.	A. Alexander Ramsay.
G. A. Goyder.	Edward H. Rennie.

W. F. Butcher.

Harker, George,

35, Boulevarde, Petersham, Sydney, N.S.W.

Student. B.Sc. in Chemistry (1st Class Honours), 1899. Junior Demonstrator in Chemistry, University of Sydney, from September, 1898, to June, 1899. *Research Work.* "On the Composition of

N.S.W. Labradorite and Topazes, with a Comparison of Methods for the Estimation of Fluorine," *Journ. Roy. Soc. N.S.W.*, 1899. Two papers "On the Alkaloids of Australian Plants," and "On the Estimation of Nicotine and on the Amount of Nicotine in N.S.W. Tobaccos," were read before the Australasian Assoc. Adv. Science, January, 1900.

A. Liversidge.	J. A. Schofield.
F. H. Guthrie.	Basil Turner.

William M. Hamlet.

Hemingway, Frank C. R.,

Albyns, Forest Road, Walthamstow.

Works Manager. (1) Matriculated Student of the University of London, with a view to eventually taking his B.Sc. degree. (2) Sometime Analyst with the Illinois Steel Company in Chicago, U.S.A. (3) And since engaged in general research work, particularly on Tin and Arsenic, and Chemistry in connection with Colour making.

D. Lloyd Howard.	Thomas Tyrer.
Samuel Hall.	B. E. R. Newlands.

Arthur R. Ling.

Henderson, John Brownlie,

Brisbane, Queensland.

Government Analyst for the Colony of Queensland. For about two years Assistant Science Master to Govan School Board, Glasgow, then Student under, and for over a year Research Assistant to, Dr. Dittmar, Anderson's College, Glasgow ("Atomic Weight of Hydrogen," Dittmar and Henderson, 1890, principal work). For about two years Science Master in Brisbane Grammar School, and since June, 1893, Government Analyst to the Colony of Queensland. (Annual Report in Mines Departments of Queensland Reports).

James Robson.	Thomas Gray.
Chas. A. Fawsitt.	*G. G. Henderson.*

Matthew A. Parker.

Hewitt, Samuel,

3, Chester St., Norwich.

Science Master to Norwich School Board, and Assistant Lecturer and Demonstrator in Chemistry Norwich Technical Institute. Certificated by Board of Education, South Kensington, as qualified to teach Theor. and Pract. Chemistry. One year's experience in Labs. of Technical College, Bradford. Two years as student, Biological Laboratory, Yorkshire College, Leeds.

Francis Sutton.	*E. C. Thompson.*
F. Napier Sutton.	*James Foulds.*
R. S. Cahill.	*T. W. Lockwood.*

Hewitt, William Henry,

115, Fentiman Road, London, S.W.

Science Teacher. (1) Associate in Chemistry of the Royal College of Science. (2) Senior Science Teacher, Strand School, King's College London. (3) (B.A. London University).

William A. Tilden.
Chapman Jones.
W. Palmer Wynne.
M. O. Forster.
G. T. Morgan.

Hudson, Edmund Foster,

Churcher's College, Petersfield, Hants.

Science Master. B.A. Cambridge, late Scholar and sometime Assistant Demonstrator of Chemistry, St. John's College. 1st Class Natural Sciences Tripos, Part I., 1898. 3rd Class Natural Sciences Tripos, Part II., 1899.

H. Brereton Baker.
W. J. Sell.
R. H. Adie.
W. T. N. Spivey.
K. C. Browning.
H. J. H. Fenton.

Jappé, Adolf,

Broad Oak, Oak Avenue, Bradford.

Analytical Chemist. 3 years pupil, and 7 years and at present Chief Assistant to F. W. Richardson, F.I.C., City Analyst for Bradford, &c. Acknowledged for research assistance by F. W. Richardson in different papers in *J. S. C. I.* Also conjoint author of paper on "Glycerine Estimation" in *J. S. C. I.*, April 30, 1898, and on "Water Softening Power of Soaps," *J. S. C. I.*, 1899, p. 998, &c.

F. W. Richardson.
Alfred H. Allen.
H. E. Aykroyd.
Walter Leach.
G. W. Slatter.

Jones, Humphrey Owen,

Clare College, Cambridge.

Assistant Demonstrator of the University Chemical Laboratory. B.A. (Camb.). First Class Natural Science Tripos, Parts I and II, with distinction in Chemistry. B.Sc. (London and Wales). Joint author with Mr. H. J. H. Fenton, M.A., F.R.S., of the two papers, "Oxidation of Organic Acids in Presence of Ferrous Iron," and "Oxalacetic Acid."

G. D. Liveing.
H. J. H. Fenton.
W. J. Sell.
W. T. N. Spivey.
S. Ruhemann.

Kilner, George Washington,

14, St. John's Park, Upper Holloway, N.

Barrister-at-Law. M.A. (London Univ.). Intermediate Science (London Univ.). Student in Chemistry at Northern Polytechnic Institution (Honours Stage).

J. T. Dunn.	Charles E. Cassal.
John Spiller.	*W. H. Corfield.*
Henry Kenwood.	*R. C. T. Evans.*

Lamb, Morris Charles,

Herold's Institute, Drummond Road, Bermondsey, London, S.E.

Head of Leather Dyeing Laboratory, Herold's Institute, London, S.E. Assistant and afterwards Demonstrator for seven years in the Leather Industries Laboratory of the Yorkshire College, assisting Prof. Proctor in Research and Analytical Work. Member (late Sec.) International Association of Leather Trades' Chemists. Contributed a paper (part Research Work) to the Society of Dyers and Colourists on the "Application of Aniline Dyestuffs to Leather." It appeared in the Journal of the Society, July, 1900. Has recently communicated a Research on the Microscopic Detection of the Adulterants of Sumach to the Society of Dyers and Colourists, *Journal of the Society of Dyers and Colourists*, March 1899.

Henry R. Procter.	A. G. Perkin.
Arthur Smithells.	J. J. Hummel.

G. W. Slatter.

Lander, George Druce,

1, Balmoral Road, Nottingham.

Lecturer and Demonstrator in Chemistry, University College, Nottingham. Author of following communications to Transactions of the Chemical Society: *Conjointly with Prof. Japp, F.R.S.*, "Condensation of Benzil with Ethylic Acetoacetate," 1896; "Synthesis of Pentacarbon Rings," Pts. I and II, 1897; "Reduction of Desyleneacetic Acid," 1897. *Conjointly with Prof. Purdie, F.R.S.*, "Optically Active Alkyloxypropionic Acids," 1898; "The Action of Alkyl Iodides on Silver Malate and on Silver Lactate," 1898; and of "Alkylation by means of Dry Silver Oxide and Alkyl Halides," 1900.

T. E. Thorpe.	T. Purdie.
F. R. Japp.	W. Palmer Wynne.

F. Stanley Kipping.

M'Call, William,

Rio Marina, Isola d'Elba, Italy.

Analytical Chemist. Head Chemist and general representative in Italy for Messrs. H. Borner and Co., of London. Four and a half years in the employment of Messrs. Tatlock and Thomson, of Glasgow, engaged in general analyses. Hold first class certificates of the Glasgow and West of Scotland Technical College in Chemical Engineering and Metallurgy. Three years' experience as chemist and representative in the Mines of Elba for Messrs. H. Borner and Co., Ltd.

R. R. Tatlock.	Robt. D. Connell.
R. T. Thomson.	James E. Ferguson.

Edmund J. Mills.

Nightingale, Thomas Marginson, B.Sc.,
375, Bridgman Street, Bolton.

Science Teacher. Central Higher Grade Board School, Bolton. Three years Student in the Owens College. B.Sc. (Chemistry and Physics) Victoria University, 1895. Teaching Chemistry for last five years.

H. B. Dixon.	W. H. Perkin, jun.
G. H. Bailey.	*W. T. Lawrence.*
Wm. A. Bone.	*D. L. Chapman.*

Pardy, Alexander,
Pietermaritzburg, Natal, South Africa.

Analyst. Analyst to the Agricultural Department, Natal. I studied Chemistry (Theoretical and Practical) during the years 1894—1897 at the University of Aberdeen, taking both General and Agricultural Chemistry. Hold the Senior Certificate of the Royal Agricultural Society of England, 1897. Received the Diploma in Agriculture of the Aberdeen University, 1897. Am at present in the service of the Natal Government Agricultural Department in charge of the Analytical Department, engaged in the investigation of soil problems, investigating the mealie and maize disease, improvement of soils, selection of fruit, &c., advising farmers; have had numerous papers and reports published on liming, farmyard manure, &c., &c.

F. R. Japp.	James Hendrick.
T. S. Murray.	Alex. Findlay.
M. S. Stanger Higgs.	E. Nevill.

Paul, John,
Bacteriological Institute, Grahamstown, Cape Colony.

Analyst. Chemical Assistant, Colonial Bacteriological Institute, Grahamstown, Cape Colony. Late Chemical Assistant, Pathological Laboratory of the London County Council, Woodford.

Stevenson Macadam.	Stevenson Macadam, jr.
W. Ivison Macadam.	*J. Falconer King.*
Bernard Dyer.	*G. H. Gemmell.*

Pearce, Ernest Vivian,

The Beeches, Hayle, Cornwall.

Chemist to the Mellanear Tin Smelting Co., Hayle. Teacher under the Cornwall County Council, 1896—97. Student at Camborne School of Mines, 1893—95. Chemist to Mellanear Smelting Co. 1895 to present time.

John J. Beringer. John Gill.
William Bate. Henry William Hutchin.
Heinrich Rowland Beringer.

Stapleton, Henry Ernest,

St. John's College, Oxford.

Professor of Chemistry. B.A.; Scholar of St. John's College, Oxford; 1st Class Final Honours School of Chemistry, Oxford, 1899; has worked some time with Dr. Ruhemann, of Caius College, Cambridge, and published with him several papers on Organic Chemistry in the Journal of the Chemical Society; Professor of Chemistry, Presidency College, Calcutta.

V. H. Veley. H. L. Bowman.
Percy Elford. A. Hartridge.
J. E. Marsh.

Thornton, Arthur Lambert,

2, Park Street, Bolton.

Science Teacher under the School Board of Bolton and the Technical Instruction Committee of Bolton. Bachelor of Science (Victoria University). Studied in the Owens College Chemical Laboratories during the years 1891—1894.

G. H. Bailey. H. B. Dixon
W. H. Perkin, jun. *J. F. Thorpe.*
Wm. A. Bone.

Wiechmann, Ferdinand Gerhard, Ph.D.,

771, West End Avenue, New York.

Consulting Chemist. The American Sugar Refining Company, New York. Results of research work published in various American and European journals. Author of "Sugar Analysis," "Lecture Notes in Theoret. Chemistry," "Chemistry: its Evolution and Achievements." Teacher of Chemistry for 14 years at School of Mines, Columbia University. Actively engaged in Sugar-chemistry and technology for 17 years.

Arthur H. Elliott. J. H. Wainwright.
Elwyn Waller. *Marston Taylor Bogert.*
Edmund H. Miller.

Wills, George Sampson Valentine,

"Southwood," Croham Road, South Croydon.

Chemist. Author of "Vegetable Organic Materia Medica." Principal of the Westminster College of Chemistry. Analyst, &c.

A. E. Bell.
Lester Reed.
Edward D. Gravill.
Fred. E. Johnson.
H. Irving Foster.
S. Hill.

Woodbridge, Walter Bourne,

Grey Friars, Chichester.

A. C. G. I. (Chemical Dept.); now engaged in sugar works in N. Germany.

Henry E. Armstrong.
Edwin C. Jee.
William A. Davis.
T. Martin Lowry.
William A. Lethbridge.

Wright, Herbert Edwards,

1, Brewers Street, St. Aldate's, Oxford.

M.A. (Cantab.). Brewer. Student under Professor Graham at Univ. Coll., London. Author of "A Handy-book for Brewers" (Crosby, Lockwood & Son). 1st ed., 1892; 2nd ed., 1897.

Charles Graham.
Lawrence Briant.
F. G. Adair Roberts.
Alfred Collett Young.
A. Boake.
C. H. H. Walker.

The following Certificates were authorised by Council under Bye-Law I (3):—

Aston, Bernard Cracroft,

Wellington, New Zealand.

Chemist to the N.Z. Agricultural Department. Was for three years Analyst at the Milburn Lime and Cement Works, Dunedin, N.Z.; two years Analyst under Licensing Acts for Province of Otago, N.Z.; for past eighteen months in present position. Joint Author of a paper on the Chemistry of the Poisonous Tutu Plant of N.Z. (*Coriaria, sp.*).

Thomas H. Easterfield.
J. M. Mason.

Bilimoria, Hormasji Naoroji, M.A., B.Sc.,

28, Wellington Street, Bombay, India.

Officiating Chemical Examiner to Government, Burma; Officiating Lecturer in Chemistry, Rangoon College, Rangoon. M.A. and B.Sc.

(Bombay), with Honours in Chemistry and Physics. Officiating Chemical Examiner to Government, Burma. Officiating Lecturer in Chemistry, Rangoon College, Rangoon. Past five years' experience in Teaching Chemistry.

Andrew Campbell

Meyer, Hans, Ph.D.,

Prag, Austria, 1 Salmgasse.

Docent and Adjunct of the Imperial and Royal German University. Publications: *Anleitung zur quant. Bestimmung d. organ. Atomgruppen.* Berlin: Jul. Springer, 1897. Auth. translation, "Determination of Radicles in Carbon Compounds," by J. B. Tingle. New York: John Wiley and Sons, 1899. Papers: "Derivatives of picolinic acid and their conversion into α-amidopyridine," 66, i, 425; "Detection and estimation of alkyl groups attached to nitrogen," 66, ii, 219. "Estimation &c., II," 68, ii, 296; "Anemonin" 70, A., i, 623, "Estimation &c., III," 70, A., i, 68; "Phthaleins," 70, A., i, 237, 238; "Phthalein derivatives," 72, A., i, 69; "Cantharidin," 74, A., i, 41; "Estimation &c., IV," A., i, 53; "Pilocarpidin," 74, A., i, 389; "Constitution of phenolphthalein," 76, i, 707; "Isomerides of Cantharidin," 76, i, 380; "Anemonin, II," 76, i, 930; "Action of ammonia on lactones," 76, i, 9; "Amino-deriv. of cantharidin," [1900]; "Amino-acids," [1900].

Bohuslav Brauner. *William Ramsay.*
Wyndham R. Dunstan.

RAMMELSBERG MEMORIAL LECTURE.

The Rammelsberg Memorial Lecture will be delivered by Professor H. A. Miers, D.Sc., F.R.S., on Thursday, December 13th, 1900, at 8.30, p.m.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for Grants, to be made on forms which can be obtained on application to the Assistant Secretary, must be received on or before November 30th.

At the next meeting, on Thursday, December 6th, the following papers will be communicated.

"Santalonic acid." By Alfred C. Chapman, F.I.C.

"Ammonium bromide and the atomic weight of nitrogen." By A. Scott.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 12/12/1900

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 16. No. 229.

December 6th, 1900. Professor Thorpe, C.B., F.R.S., President, in the Chair.

The following certificates were read for the first time:—Messrs. Andrew Charles Aitken, Rio Marina, Isola d'Elba, Italy; Thomas Stewart Barrie, 77, Sinclair Drive, Langside; John Cardew Bedwell, 65, High Street, Colchester; Herbert John Bult, 165, Brixton Hill, S.W.; Gilbert Howard Daniel, 21, Church Walk, Ulverston; Frederick George Donnan, Chemical Laboratory, University College, Gower Street, W.C.; John Alfred Emery, Cinderford, Gloucestershire; Bernard Farmborough Howard, Devon House, Buckhurst Hill, Essex; Nicholas Henry Martin, Ravenswood, Low Fell, Gateshead; Theodore Henry Page, 40, Wilson Road, Camberwell, S.E.; Thomas Slater Price, University College, Sheffield; Lionel Guy Radcliffe, 6, Alma Terrace, Old Trafford, Manchester; William Cecil Ramsden, 13, Effra Road, Rathmines, Dublin; John Talbot, Tunstall House, Harrow; James Waterhouse, Oak Lodge, Court Road, Eltham, Kent; William A. Wayland, 4, Harefield Road, Brockley, S.E.; James Scott Wilson, Bradford Street, Walsall.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:—Messrs. Bernard Cracroft Aston; George L. Bennett, M.A.; Hormasji N. Bilimoria, M.A., B.Sc.; Frederick Nisbet Binks; Herbert James Singleton Boyes; Theodore Ridley Burnett, Ph.D.; John Henry Cheeseright; Albert Walter Comber; Alexander Davidson; Arthur Louis William Fechtner; Willie

Ludford Freeman, B.A.; William Gasson; George William Gibbings; John Gibson; Walter Augustus Handcock; William A. Hargreaves, M.A.; George Harker, B.Sc.; Frank C. R. Hemingway; John Brownlie Henderson; Samuel Hewitt; William Henry Hewitt, B.A.; Edmund Foster Hudson, B.A.; Adolf Jappé; Humphrey Owen Jones, B.A., B.Sc.; George Washington Kilner, M.A.; Morris Charles Lamb; George Druce Lander, B.Sc.; William McCall; Hans Meyer, Ph.D.; T. Marginson Nightingale, B.Sc.; Alexander Pardy; John Paul; Ernest Vivian Pearce; Henry Ernest Stapleton, B.A.; Arthur Lambert Thornton, B.Sc.; F. Gerhard Wiechmann, Ph.D.; Walter Bourne Woodbridge; Herbert Edwards Wright, M.A.

Of the following papers, those marked * were read :—

*153. "Santalenic acid." By Alfred C. Chapman, F.I.C.

The author described the preparation of a crystalline acid by the oxidation of oil of santal wood with a neutral aqueous solution of potassium permanganate. *Santalenic acid* has the formula $C_{13}H_{19}O_2$. It crystallises from dilute alcohol in transparent plates possessing a brilliant pearly lustre, is insoluble in water, but dissolves readily in all the ordinary organic solvents. It melts at 76°, boils without decomposition at 189° (corr.) under a pressure of 28 mm., and distils with steam.

Its rotation has been determined and gives $[\alpha]_D = +18{\cdot}05°$.

Many of its salts have been prepared and analysed. The *methyl ester* is an oily liquid boiling at 232—234° (35 mm.), and has a sp. gr. = 1·0132 at 15°/15°. In a 100 mm. tube at 20° it produces a rotation of $-18°13'$.

*154. "Ammonium bromide and the atomic weight of nitrogen."
By A. Scott.

During a research having for its chief aim the determination of the hydrogen to oxygen ratio by comparing the equivalents of hydrazine, ammonia, and hydroxylamine, the author found that he could not obtain the same equivalent as Stas for ammonium bromide. The value given by Stas is 98·032, whilst that of the author is 97·996, his highest value being 98·003. This would lower the atomic weight of nitrogen from 14·046 to 14·010, a number much nearer that deduced from the relative densities of oxygen and nitrogen (16 : 14·003).

The bromide used by Stas seems to have contained some impurity, probably platinum, as it turned greyish at 115°, and its greyness increased up to 180°; he was unable to sublime it even in ammonia without its becoming yellow. The ammonium bromide of the author retains its whiteness at 180° and has been sublimed in ammonia, in a mixture of hydrogen with ammonia and in a vacuum, giving the same results before and after sublimation. The silver bromide had the same composition as that of Stas (57·445 per cent. of silver).

The equivalent for ammonium chloride was also determined, and found to be 53·516, as against 53·532 (Stas) and 53·486 (Marignac).

The silver used was prepared by the reduction of silver nitrate by means of ammonium formate, and was notably better than a sample prepared with the utmost care by the well-known cuprous ammonium sulphite process.

To test the purity of the silver in the severest way, the precipitated silver bromide was reduced by hydrogen, when identical results were obtained with the silver so prepared.

*155. "Relationships of oxalacetic acid." By Henry J. Horstman Fenton, F.R.S., and Humphrey Owen Jones, B.A., B.Sc.

The authors have continued their investigations on the properties and relationships of free oxalacetic acid, obtained by the oxidation of malic acid in presence of ferrous iron.

The behaviour of the acid towards ammonia, aniline, hydrazine, phenylhydrazine hydroxylamine and urea was discussed as well as the relation of the acid to dihydroxymaleic and dihydroxytartaric acids.

It was also shown that the hydrazone of oxalacetic acid readily loses carbon dioxide when heated with water, yielding the hydrazone of pyruvic acid, but that by a sufficient concentration of hydrogen ions this change is prevented, the hydrazone losing water instead and giving Wislicenus' phenyl-pyrazolone-carboxylic acid; a simple method based upon these changes has been devised for comparing the 'strengths' or 'affinities' of various acids.

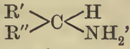
*156. "The alkaloids of 'Corydalis cava.' The conversion of corybulbine into corydaline." By James J. Dobbie, D.Sc., M.A., Alex. Lauder, B.Sc., and Photios G. Paliatseas.

Corydaline, $C_{18}H_{15}N(OCH_3)_4$, differs from corybulbine, $C_{18}H_{16}NO(OCH_3)_3$, by CH_2, and contains four methoxyl groups, whilst the latter alkaloid contains only three (*Trans.*, 1895, 67, 25). The authors have now proved that corybulbine contains a hydroxyl group and forms a mon-acetyl derivative, $C_{18}H_{15}N(OCH_3)_3O{\cdot}C_2H_3O$. By treatment with concentrated hydrogen iodide the two alkaloids yield the same phenolic derivative, $C_{18}H_{15}N(OH)_4,HI$. Corybulbine can be readily converted into corydaline by treatment with equivalent quantities of methyl iodide and potassium hydroxide in methyl alcohol solution. The artificial corydaline agrees in melting point, solubility in various reagents and specific rotation with the natural alkaloid. The platinichloride, ethyl sulphate and hydriodide of the natural and artificial substances have been compared and found to be identical.

*157. "The inversion of the optically active *ac*-tetrahydro-β-naphthylamines, prepared by the aid of dextro- and lævo-bromocamphorsulphonic acids." By William Jackson Pope and Alfred William Harvey.

Dextro-*ac*-tetrahydro-β-naphthylamine dextrobromocamphorsulphonate has been previously prepared from racemic *ac*-tetrahydro-β-naphthylamine hydrochloride (*Proc.*, 1899, 15, 170); it was now shown that on treating the hydrochloride extracted from the mother liquors with ammonium lævobromocamphorsulphonate, a precipitate of l-*tetrahydronaphthylamine* l-*bromocamphorsulphonate* falls and may readily be obtained in a pure state. The new salt gives $[\alpha]_D = -86{\cdot}2°$ in solution in absolute alcohol, as against $[\alpha]_D = +86{\cdot}5°$ for its optical antipodes.

It has been shown that in preparing the benzylidene, benzoyl and acetyl derivatives of *d*-tetrahydronaphthylamine the major portion of the base undergoes optical inversion (this vol., 74); on liberating the base from its salts by soda and preparing the hydrochloride considerable racemisation also occurs, the optically active hydrochlorides being only separable with difficulty from the mixed salts; the enantiomorphously-related hydrochlorides gave in aqueous solution $[\alpha]_D = +71{\cdot}9°$ and $-69{\cdot}7°$ respectively. The optical inversion seems to occur during the liberation of the base by soda. *d*-Tetrahydronaphthylamine *d*-camphorsulphonate and its enantiomorphously-related isomeride are more easily purified than the corresponding hydrochlorides; these salts crystallise with half a molecule of water, and, after drying, give in aqueous solution $[\alpha]_D = +47{\cdot}7°$ and $-47{\cdot}4°$. The purest specimen of *d*-tetrahydronaphthylamine, obtained by treating the bromocamphorsulphonate with soda and distilling under reduced pressure, gave $[\alpha]_D = +37{\cdot}24°$ in a 100 mm. tube; this still contained about 30 per cent. of the lævo-rotatory base, so that the pure dextro-base would have given $[\alpha]_D = +96°$ approximately.

Optical inversion attending the liberation of a base from its salts has not been previously observed, but E. Fischer has shown that leucine and glutaminic acid undergo partial racemisation on benzoylation; these substances all contain the group  $\genfrac{}{}{0pt}{}{R'}{R''}{>}C{<}\genfrac{}{}{0pt}{}{H}{NH_2}$, and the partial optical inversion is probably due to part of the base being momentarily converted into a substance containing a group of the type ${}^{R'}_{R''}\!>\!C{:}NH_3$ during conversion of an addition compound into one containing triad nitrogen.

*158. "The alkaloids of 'Hyoscyamus muticus' and of 'Datura Stramonium' grown in Egypt." By Wyndham R. Dunstan and Harold Brown."

In a previous paper (*Trans.*, 1899, **75**, 72), the authors showed that *Hyoscyamus muticus* grown in India contained 0·1 per cent. of hyoscyamine which is readily isolated in a pure state. Subsequently Gadamer (*Archiv der Pharmazie*, 236, **9**, 704) in a brief note recorded the fact that the same plant grown in Egypt contains more than ten times this quantity. Through the kindness of Mr. E. A. Floyer, the authors have been enabled to examine a specimen of the plant from Egypt. They find it to be much richer in hyoscyamine than the sample of Indian growth previously examined. The seeds furnished 0·87 per cent. and the stems and leaves 0·59 per cent. It remains to be determined whether the Indian plant is always poorer in alkaloid or whether it was a peculiarity of the sample examined.

The authors call attention to the Egyptian plant as an important source of the alkaloid hyoscyamine.

Datura Stramonium grown in the Egyptian desert also contains hyoscyamine, unaccompanied by other atropaceous alkaloids, to the extent of 0·35 per cent.

An abundant supply of either plant could be obtained from Egypt.

159. "Interaction of urethanes and primary benzenoid amines."

By Augustus Edward Dixon, M.D.

Manuelli and Comanducci have described (*Gazz.*, 1899, **29**, ii, 142) as phenylparatolylcarbamide, PhNH·CO·NHTo, a substance they obtained by heating phenylurethane with paratoluidine; they give its melting point as 259—260°, and confirm the formula by a complete analysis. These chemists have apparently overlooked the descriptions of phenylparatolylcarbamide given by Huhn (*Ber.*, 1886, **19**, 2408), Goldschmidt and Meissler (*Ber.*, 1890, **23**, 273) and the author (*Trans.*, 1895, **67**, 562), who record the melting point as 211°, 211°, and 212—213° respectively; Paal and Vanvolxem (*Ber.*, 1894, **27**, 2426) give its melting point as 212°.

It occurred to the author as just possible that Manuelli and Comanducci's compound might be a 'labile' form of the symmetrical carbamide, for instance, PhN:C(OH)·NHTo; in order to find out if the discrepancy noted above might be thus explained, the interaction of certain urethanes and aromatic bases was investigated.

Phenylurethane and paratoluidine, when heated together, yielded aniline and a crystalline solid; the latter consisted of a main portion melting at 260—261°, which was proved to be, not phenylparatolyl-, but diparatolyl-carbamide, along with a small quantity of phenylparatolylcarbamide melting at 213—214°. It is suggested that the production of diparatolylcarbamide is due to the expulsion of aniline by toluidine from the phenyltolylcarbamide initially formed, the actions occurring as follows:

(I) $PhNH{\cdot}CO{\cdot}OEt + ToNH_2 = EtOH + PhNH{\cdot}CO{\cdot}NHTo$.

(II) $PhNH{\cdot}CO{\cdot}NHTo + ToNH_2 = PhNH_2 + CO(NHTo)_2$.

Aniline heated with paratolylurethane, gave a solid product which consisted mainly of phenylparatolylcarbamide, m. p. 213—214°, with only a small quantity of a substance melting at about 256—257°, probably diparatolylcarbamide.

From orthotoluidine and phenylurethane, aniline always was liberated, the solid product being a mixture, from which were separated (1) vitreous prisms, melting at 249—250° (diorthotolylcarbamide), and (2) woolly-looking clumps of needles melting at 203—204°; these were nearly pure phenylorthotolylcarbamide. The latter compound, when prepared by acting with silver nitrate on the corresponding thiocarbamide, or from phenyl isocyanate and orthotoluidine, melted at 207—208°.

It seemed, therefore, not improbable that the *s*-phenyl-α-naphthylcarbamide prepared by Manuelli and Comanducci from phenylurethane and α-naphthylamine, and stated to melt at about 277—278°, might prove to be really di-α-naphthylcarbamide; this interaction was therefore re-examined. Phenyl-α-naphthylcarbamide was prepared in two distinct ways and found to melt at 222—223°. Immediately after melting it resolidifies, remelting about 20° higher; the cause of this behaviour has not yet been investigated.

When phenylurethane was heated with α-naphthylamine as described, much aniline was formed, together with a solid mixture, which, when boiled with alcohol, left di-α-naphthylcarbamide, which is nearly insoluble, and melts rather indistinctly at 286—287°; from the extract a small quantity of a substance was deposited which crystallised from alcohol in woolly-looking needles. This melted at about 221°, resolidifying immediately, as described above, and evidently consisted of phenyl-α-naphthylcarbamide.

Manuelli and Comanducci also obtained from normal amylamine and phenylurethane a colourless solid, melting at 238°, which they regard as *ab*-amylphenylcarbamide, but which the author thinks is probably carbanilide.

160. "The decomposition of chlorates. Part III. Calcium chlorate and silver chlorate." By William H. Sodeau, B.Sc.

When calcium chlorate is decomposed slowly, about 0·6 per cent. of its total chlorine is evolved, whether the pressure be 760 mm. or 4 mm., but the proportion exceeds 2 per cent. when the decomposition under atmospheric pressure is rendered violent. As the proportion of free chlorine is independent of the pressure of the gaseous products, the calcium chloride in the residue is not produced by the action of chlorine upon oxide first formed.

When silver chlorate is heated to about 350° it explodes with a yellow flash, about 7 per cent. of its chlorine accompanying the oxygen. When slowly decomposed the influence of pressure is even greater than in the case of lead chlorate (*Trans.*, 1900, **77**, 718). At atmospheric pressure only 0·2 per cent. of its chlorine remains free, but 22·6 per cent. is obtained at 2½ mm. pressure, and more than 36 per cent. should be obtained if the action between chlorine and silver oxide could be completely eliminated.

It is concluded that oxygen and chlorine are produced during the slow decomposition of either chlorate by two simultaneous independent reactions represented by the equations $2M(ClO_3)_2 = 2MCl_2 + 6O_2$ and $2M(ClO_3)_2 = 2MO + 2Cl_2 + 5O_2$ (where $M = Ca$ or Ag_2). With calcium chlorate the "chloride" decomposition proceeds at about 180 times the rate of the "oxide" decomposition, whilst with silver chlorate the ratio is less than 1·8 : 1.

The probability of the "oxide" decomposition being endothermic suggests an explanation of the increase of chlorine in rapid decomposition at high temperature.

Silver chlorate differs from the chlorates of potassium, barium and calcium in its highly explosive nature and in the occurrence of an extremely strong secondary action between chlorine and the oxide, but resembles the chlorates of potassium, barium, calcium and lead, in that no free chlorine is produced by displacement from the chloride.

161. "On iron nitride." By G. J. Fowler, M.Sc.

Nitride of iron was prepared by three different methods: by the action of ammonia on (*a*) finely divided iron, (*b*) ferrous chloride and bromide, (*c*) iron amalgam. Of these methods (*a*) is the most convenient. The substance was found to correspond to the formula Fe_2N. The temperatures of the formation of iron nitride in ammonia and of its decomposition in hydrogen are identical. These results confirm the conclusions of Stahlschmidt. Heated in a current of nitrogen, iron nitride begins to decompose at about 600°; it is slightly magnetic; its specific gravity is 6·35.

When oxidised in air or oxygen, only traces of oxides of nitrogen are produced; heated in a current of air, the substance begins to be converted into ferric oxide and nitrogen at about 200°. It takes fire in chlorine either spontaneously, or when slightly warmed, ferric chloride and nitrogen being formed, but no trace of nitrogen chloride. It is only slowly attacked by bromine, the action probably being due to the presence of hydrobromic acid in the bromine as an impurity. An ethereal solution of iodine has no action on it.

Dilute hydrochloric and sulphuric acids yield the corresponding ferrous and ammonium salts, hydrogen being liberated, according to the following equation: $2Fe_2N + 6H_2SO_4 = 4FeSO_4 + 2NH_4HSO_4 + H_2$.

The simultaneous action of hydrogen peroxide and sulphuric acid is not distinguishable from that of the acid alone. Nitric acid acts only slowly on the nitride even when strong; the products formed vary with the concentration of the acid.

Gaseous hydrochloric acid begins to attack the nitride at about 220°, and at 350° the reaction becomes rapid, the substance being completely converted into ferrous chloride and ammonium chloride. Gaseous hydrogen sulphide has a precisely similar action at 200°.

Nitric oxide acts similarly to oxygen, and converts the nitride into oxide, the reaction beginning at about 120° and becoming rapid at 170°. Carbon dioxide oxidises the nitride at about 530°. On heating the nitride in steam at 100°, ammonia is very slowly formed. The nitride heated with sodium and carbon yields sodium cyanide.

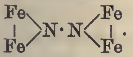
It was thought that phenol might act on nitride of iron in the same way as dilute acids, but the two substances do not react.

On heating with ethyl iodide in a sealed tube to 200—230°, gas is produced consisting chiefly of olefines, with a trace of paraffins, but no amines. The reaction may probably be thus represented: $Fe_2N + 5C_2H_5I = NH_4I + 5C_2H_4 + 2FeI_2$.

162. "The heat of formation and constitution of iron nitride." By Gilbert John Fowler, M.Sc., and Philip J. Hartog, B.Sc.

To determine the heat of formation of iron nitride, the substance was dissolved in dilute sulphuric acid (containing 49 grams to the litre) as represented by the equation $Fe_2N + 3H_2SO_4,Aq = 2FeSO_4,Aq + NH_4HSO_4,Aq + H$. A current of nitrogen was passed through the solution to avoid oxidation of the ferrous salt, as the reaction is a slow one, though it eventually becomes complete. The mean of three determinations gave as the thermal value of the reaction +81·56 cals. From this value the heat of formation of iron nitride is calculated to be

+3·04 cals. It is suggested that the constitution of iron nitride is



163. "Infracampholenic acid: an isomeride of campholytic and isolauronolic acids." By M. O. Forster.

By hydrolysing the unsaturated nitrile formed when the anhydride of bromonitrocamphane is treated with hot, aqueous sodium hydroxide (Trans., 1899, 75, 1141), *infracampholenic acid*, $C_9H_{14}O_2$, is obtained as a viscous oil boiling at 145° and 239°, under pressures of 24 mm. and 758 mm. respectively; it is optically inactive, and is transformed into isolauronolic acid by hot, dilute, sulphuric acid. The *dibromide*, $C_9H_{14}O_2Br_2$, produced when a cold solution of bromine (1 mol.) is added to the acid dissolved in chloroform and surrounded by a freezing mixture, crystallises from warm petroleum in minute, white needles, which melt at 125° to a colourless liquid which evolves gas. *Tribromodihydroinfracampholenic acid*, $C_9H_{13}O_2Br_3$, obtained when infracampholenic acid is submitted to the action of bromine under the conditions which lead to the conversion of campholytic acid into its dibromide, crystallises from ethyl acetate, and melts at 182° to a colourless liquid which evolves gas.

Aminoinfracampholene, $C_8H_{13}{\cdot}NH_2$, prepared from the amide of infracampholenic acid by the action of sodium hypobromite, is a colourless oil which boils at 158—160° under 754 mm. pressure, and has a sp. gr. 0·8770 at 14°. The *hydrochloride* melts at 213°, the *platinichloride* at 238—240°, and the *picrate* at 213°; the *benzoyl*, *carbamide*, and *phenylcarbamide* derivatives melt at 105°, 182°, and 180° respectively.

164. "Tutu. Part I." By Thomas Hill Easterfield and Bernard Cracroft Aston.

The authors have examined three varieties of tutu—*Coriaria ruscifolia*, *C. thymifolia*, *C. angustissima*—which cause serious loss of stock in New Zealand, and have isolated from them a glucoside, *tutin*, $C_{17}H_{20}O_7$, along with acetic, gallic, succinic and other acids. From *C. thymifolia* quercitin or an isomeric compound was obtained; and from *C. angustissima* a volatile acid, $C_8H_8O_4$, which has not been identified.

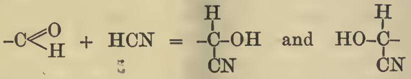
Tutin was obtained in colourless crystals melting at 208—209° (uncorr.), and is perceptibly volatile at 120—130°. Its solubility is 1·9 grams in 100 grams water at 10°; 1·5 grams in 100 grams ether at 10°; 8·2 grams in 100 grams alcohol at 16°. It is very soluble in acetone, sparingly soluble in chloroform, insoluble in benzene and carbon disulphide. Its optical rotation was determined, and gives $[\alpha]_D^{19^\circ} = +9{\cdot}25^\circ$.

The authors also discussed the formula for coriamyrtin, and conclude that the formula, $C_{15}H_{18}O_5$, which is half that usually accepted, harmonises better with the facts. A comparison of the chemical and physical characters of tutin and coriamyrtin proved that these substances are not identical.

A note by Professor Marshall on the pharmacology of tutin states that its action is similar to that of coriamyrtin, but is more slowly produced, and it is much less toxic. Its action is exerted mainly on the medulla oblongata and the basal ganglia of the brain.

165. "Experiments on the production of optically active compounds from inactive substances. Preliminary notice." By J. B. Cohen and C. E. Whiteley.

E. Fischer has shown (*Annalen*, 1892, **270**, 64) that in the synthesis of one sugar from another by the addition of hydrocyanic acid to the lower member, a new asymmetric carbon atom is introduced, which may give rise to two stereoisomeric compounds. This may be represented as follows:



$$-C{<}^{O}_{H} + HCN = -\overset{\displaystyle H}{\underset{\displaystyle CN}{C}}-OH \quad \text{and} \quad HO-\overset{\displaystyle H}{\underset{\displaystyle CN}{C}}-$$

Although the two new groups are optical antipodes, the two isomerides are not necessarily so as a whole, and consequently they are not always produced in equal quantities. Fischer has found, for example, that glucose forms two cyanhydrins in very unequal quantities, whilst in the case of dextro-mannose only one of the two possible cyanhydrins is produced (Hartmann, *Annalen*, 1892, **272**, 190). It is clear, therefore, that the asymmetric molecule as a whole exerts its influence on the space configuration of the newly added asymmetric carbon group. In these examples, it is impossible to determine exactly the influence of the active part of the original molecule on the activity of the new group, seeing that the latter cannot be detached from the molecule. As the formation of active substances in living organisms is probably closely connected with their production from other active substances from which they are afterwards removed, the idea occurred to us to attempt to produce a new asymmetric carbon atom in an already active compound from which the originally active group could be subsequently detached.

A number of reactions readily presented themselves, such as the reduction, bromination or hydroxylation of esters composed of an unsaturated acid and an active alcohol, or the reduction of a ketonic ester of an active alcohol, the alcohol being afterwards removed by hydrolysis.

These reactions may be represented as follows: (X stands for an atom or group not being hydrogen, A indicates the active alkyl or aryl group, and C, the new asymmetric carbon atom):

1. (*a*) $\cdot CH{:}CX\cdot CO_2A$ (*b*) $\cdot CH_2\cdot CHX\cdot CO_2A$ (*c*) $\cdot CH_2\cdot CHX\cdot CO_2H$.
2. (*a*) $\cdot CH{:}CH\cdot CO_2A$ (*b*) $\cdot CHX\cdot CHX\cdot CO_2A$ (*c*) $\cdot CHX\cdot CHX\cdot CO_2H$.
3. (*a*) $\cdot CO\cdot CO_2A$ (*b*) $\cdot CHOH\cdot CO_2A$ (*c*) $\cdot CHOH\cdot CO_2H$.

Under (1) we have studied the reduction of the menthyl esters of mesaconic and phenylcrotonic acids.

(*a*) $CH_3\cdot C(CO_2C_{10}H_{19}){:}CH\cdot CO_2C_{10}H_{19}$

(*b*) $CH_3\cdot CH(CO_2C_{10}H_{19})\cdot CH_2\cdot CO_2C_{10}H_{19}$ (*c*) $CH_3\cdot CH(CO_2H)CH_2\cdot CO_2H$.

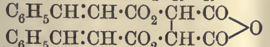
(*a*) $C_6H_5\cdot CH{:}C(CH_3)\cdot CO_2C_{10}H_{19}$

(*b*) $C_6H_5CH_2\cdot CH(CH_3)\cdot CO_2C_{10}H_{19}$ (*c*) $C_6H_5CH_2\cdot CH(CH_3)\cdot CO_2H$.

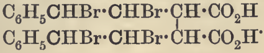
Under (2) we have prepared the bromine derivatives of the amyl and menthyl esters of cinnamic acid and of dicinnamyl tartrate, and examined the action of various reagents on the dibromo-compounds, also the action of sodium ethylate on menthyl fumarate.

(*a*) $C_6H_5CH{:}CH\cdot CO_2C_5H_{11}$ (*b*) $C_6H_5CHBr\cdot CHBr\cdot CO_2C_5H_{11}$.

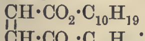
(*a*) $C_6H_5CH{:}CH\cdot CO_2C_{10}H_{19}$ (*b*) $C_6H_5CHBr\cdot CHBr\cdot CO_2C_{10}H_{19}$.

(*a*) 

$$\begin{array}{l} C_6H_5CH{:}CH\cdot CO_2\cdot CH\cdot CO \\ \qquad\qquad\qquad\quad | \qquad\quad >O \\ C_6H_5CH{:}CH\cdot CO_2\cdot CH\cdot CO \end{array}$$

(*b*) 

$$\begin{array}{l} C_6H_5CHBr\cdot CHBr\cdot CH\cdot CO_2H \\ \qquad\qquad\qquad\qquad | \\ C_6H_5CHBr\cdot CHBr\cdot CH\cdot CO_2H \end{array}$$

(*a*) 

$$\begin{array}{l} CH\cdot CO_2\cdot C_{10}H_{19} \\ \| \\ CH\cdot CO_2\cdot C_{10}H_{19} \end{array}$$

Under (3) we have investigated the reduction of menthyl pyruvate.

(*a*) $Me\cdot CO\cdot CO_2C_{10}H_{19}$ (*b*) $Me\cdot CHOH\cdot CO_2C_{10}H_{19}$ (*c*) $Me\cdot CHOH\cdot CO_2H$.

The results in all cases have been of a negative character, in spite of every care to avoid possible racemisation by conducting the reactions as far as possible at the ordinary temperature.

The experiments, which were commenced in 1898, have been delayed in consequence of unforeseen difficulties. All the experiments under (2), after a considerable loss of time, had to be abandoned. Although the dibromo-derivatives of amyl and menthyl cinnamate and of dicinnamyl tartrate could be readily obtained in a state of purity, they could not be directly hydrolysed without removing bromine, and all attempts to replace the bromine by hydroxyl failed. Menthyl fumarate, which was readily prepared from silver fumarate and menthyl chloride, gave no ethoxy-derivative by means of Purdie's reaction. Reactions (1) and (3) were, however, ultimately brought to a satisfactory conclusion.

Menthyl mesconate and menthyl phenylcrotonate were prepared by heating together menthol and the acid chloride, whilst menthyl pyruvate was obtained by heating menthol and pyruvic acid under diminished pressure. The reduction of the first two esters was effected by means of the aluminium-mercury couple in aqueous alcoholic solution, whilst menthyl pyruvate was reduced with zinc dust and acetic acid. The esters were then hydrolysed with alcoholic potash and the menthol removed with ether. The acid, after careful purification by crystallisation or precipitation of its salt, was finally examined in the polarimeter. Pyrotartaric acid, phenylmethylacetic acid, and lactic acid, obtained in this way, were all optically inactive. We propose to extend these experiments to the acid amides of optically active bases.

166. "Synthesis of isocamphoronic acid." By W. H. Perkin, jun.

When the anhydride of $CO_2H{\cdot}CMe_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$, *aa*-dimethylglutaric acid, is treated with phosphorus pentachloride and bromine and the product poured into alcohol, $CO_2Et{\cdot}CMe_2{\cdot}CH_2{\cdot}CHBr{\cdot}CO_2Et$, *ethyl bromodimethylglutarate* is obtained as a colourless oil boiling at 165—170° (35 mm.).

This on treament with alcoholic potash yields *dimethylglutaconic acid*, $CO_2H{\cdot}CMe_2{\cdot}CH{:}CH{\cdot}CO_2H$, which crystallises from water in plates melting at 172° and is possibly a stereoisomeride of the *aa*-dimethylglutaconic acid lately prepared by M. Conrad (*Ber.*, 1900, **33**, 1920) which melts at 150°. That the acid of melting point 172° has the constitution assigned to it is proved by the fact that when oxidised with permanganate at 0° it is quantitatively converted into dimethylmalonic acid and oxalic acid,

$$CO_2H{\cdot}CMe_2{\cdot}CH{:}CH{\cdot}CO_2H + 3O = CO_2H{\cdot}CMe_2{\cdot}CO_2H + CO_2H{\cdot}CO_2H.$$

Dimethylglutaconic acid is readily esterified by means of alcohol and sulphuric acid: the *ethyl dimethylglutaconate*, $CO_2Et{\cdot}CMe_2{\cdot}CH{:}CH{\cdot}CO_2Et$, thus produced, is a colourless oil boiling at 200° (200 mm.).

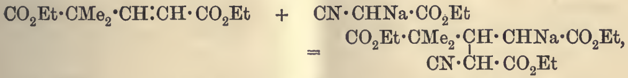
When this ester is digested in alcoholic solution with the sodium compound of cyanacetic ester, condensation takes place, and the product, on heating with dilute sulphuric acid, is almost quantitatively converted into an acid melting at 166°, and which on examination has been proved to be *isocamphoronic acid.*

(Found $C = 49{\cdot}7$; $H = 6{\cdot}5$; $C_9H_{14}O_6$ requires $C = 49{\cdot}5$; $H = 6{\cdot}4$.)

Professor von Baeyer was kind enough to send the author a sample of isocamphoronic acid which had been prepared from pinene, and on mixing equal quantities of this and the synthetical acid, no alteration in the melting point could be observed. Again, when heated with sulphuric acid at 100°, the synthetical acid is converted into *terpenylic acid*, a change which Tiemann (*Ber.*, 1896, **29**, 2613) has shown to be characteristic of isocamphoronic acid.

There can thus be no doubt that the synthetical acid is in reality isocamphoronic acid, and its synthesis solves the vexed question of the constitution of this important acid.

The condensation of ethyl dimethylglutaconate with the sodium compound of ethyl cyanacetate may be represented thus :



$$\mathrm{CO_2Et\cdot CMe_2\cdot CH\!:\!CH\cdot CO_2Et} \quad + \quad \mathrm{CN\cdot CHNa\cdot CO_2Et} = \begin{array}{l} \mathrm{CO_2Et\cdot CMe_2\cdot CH\cdot CHNa\cdot CO_2Et,} \\ \qquad\qquad\quad\;\; \mathrm{CN\cdot CH\cdot CO_2Et} \end{array}$$

and the cyanester thus produced yields, on hydrolysis and elimination of carbon dioxide, isocamphoronic acid, which, therefore, must have the constitution, $\mathrm{CO_2H\cdot CMe_2\cdot CH(CH_2\cdot CO_2H)\cdot CH_2\cdot CO_2H}$, first proposed for this acid by Tiemann (*Ber.*, 1896, **29**, 2614).

167. "On some α-alkyl substitution products of glutaric, adipic, and pimelic acids." By J. W. Mellor.

The author describes the known methods of general application for the preparation of the above acids, and gives an account of some new methods which he has employed in synthesising such acids. He finds that adipic acid itself may be readily prepared in quantity by the action of *chloropropylcyanide*, $\mathrm{Cl\cdot CH_2\cdot CH_2\cdot CH_2\cdot CN}$, on the sodium compound of ethyl malonate, and subsequent hydrolysis of the *ethyl cyanpropylmalonate*, $\mathrm{CN\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH(CO_2Et)_2}$ (b. p. 170—175° at 40 mm.), by boiling with dilute sulphuric acid. α-Alkyl substitution products of adipic acid may be obtained by employing the corresponding ethyl α-alkylmalonates in this synthesis in the place of ethyl malonate.

The author has prepared several of the known α-alkyl substitution products of glutaric, adipic, and pimelic acids in a state of purity, and determined their dissociation constants. He has also prepared *α-propyl adipic acid,* $\mathrm{CO_2H\cdot CHPr\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO_2H}$, which melts at 59° and does not appear to have been previously described.

168. "On the nature of polyiodides and their dissociation in aqueous solutions." By H. M. Dawson.

From experiments on the ratio of distribution of iodine between solutions of potassium iodide and carbon bisulphide and the simplicity of the dissociation isotherm for the equilibrium in the aqueous solution, which accords with the experimental data, it is concluded that potassium triiodide is a normal salt of potassium, which at corresponding concentrations is dissociated electrolytically to the same extent as other binary salts. Experiments with solutions of hydriodic acid lead to the conclusion that hydrogen triiodide is electrolytically dissociated to the same extent as hydriodic acid, and belongs, therefore, to the group of strong acids. These results are in harmony with Abegg and Bodländer's theory of complex compounds. From their analogy with potassium triiodide, the recently discovered trihaloid derivatives of cæsium and rubidium must be placed in the same category.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Galt, Hugh. The microscopy of the more commonly occurring starches. Ill. London. 1900. From the Publishers.

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Lewes, Vivian B. Acetylene, a handbook for the student and manufacturer. Ill. Westminster. 1900. From the Author.

Mendola, Raphael. Inorganic chemistry, non-metallic and metallic elements, with sections of inorganic analysis, laws of chemistry, chemical action, &c. Revised to date by J. Castell Evans. Fifth edition. Ill. London. 1900. From the Editor.

Moissan, Henri. Le fluor et ses composés. Paris. 1900. From Sir John Evans.

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RAMMELSBERG MEMORIAL LECTURE.

The Rammelsberg Memorial Lecture will be delivered by Professor H. A. Miers, D.Sc., F.R.S., on Thursday, December 13th, 1900, at 8.30 p.m.

At the next meeting, on Thursday, December 20th, the following paper will be communicated.

"On the union of hydrogen and chlorine." By J. W. Mellor, B.Sc.

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PROCEEDINGS

OF THE

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Vol. 16. No. 230.

December 13th, 1900. Extra Meeting. Professor THORPE, C.B., F.R.S., President, in the Chair.

Professor H. A. MIERS, D.Sc., F.R.S., delivered the Rammelsberg Memorial Lecture.

Karl Friedrich Rammelsberg was born on April 1st, 1813, at Berlin, and succeeded Heinrich Rose as Professor of Inorganic Chemistry in the University of Berlin in 1874. He was also Instructor in Chemistry (1850—1883) at the Gewerbe-akademie, which became the Technische Hochschule and was transferred to Charlottenburg in 1883; from 1883 to 1891, he was Director of the Second Chemical Institute of the University. He was twice married; in 1846, to the daughter of Oberbergrath Zincken; in 1859, to the daughter of C. G. Ehrenberg. In 1841, as Privatdocent, he started a private laboratory, in which was given the first practical chemical instruction in Berlin. He published an immense number of papers dealing with inorganic chemistry, crystallography, and mineralogy, but never himself engaged in any research work relating to organic chemistry. He was the author of numerous chemical text-books, one of which, *Grundriss der Chemie gemäss den neueren Ansichten* (1866), was the first to explain the new principles of organic chemistry. He was also the first of the old school of chemists to adopt the new system of formulæ.

Two of his books were encyclopædic works of reference: the *Handbuch der Krystallographischphysikalischen Chemie* (1855—1881) contained the crystallographic, optical, and physical constants of all crystallised compounds; the *Handbuch der Mineralchemie* (1841—1895) was an exhaustive treatise on the composition of all minerals.

He was equally eminent as Inorganic Chemist, Crystallographer, and Mineralogist. In chemistry, his work upon the halogen compounds, the phosphates, and the cyanides may be taken as samples of his researches. He prepared and studied an enormous number of bromides, of the ammonia compounds of the bromides and iodides; of bromates, iodates, and periodates; of phosphates, phosphites, and hypophosphites; our knowledge of the double cyanides is almost entirely due to him; equally laborious and important were his researches upon the sulphantimonates, hyposulphites, sulphites, nitrites, vanadates, phosphomolybdates. One of his important papers, on the Mexican amalgamation process, was communicated to this Society (1881). In crystallography, he did more than any other man to carry on the work of Mitscherlich, and investigated an immense number of isomorphous compounds; he studied the isomorphism of sulphur and selenium; he pointed out the isomorphism of vanadinite and pyromorphite, and first suggested that vanadic acid is V_2O_5; in his work upon the crystallisation of the sulphates $RSO_4,7H_2O$ from mixed solutions, he was one of the pioneers of modern physical chemistry.

In mineralogy also he contributed more than any one to our knowledge of the composition of minerals and was practically the father of modern mineral chemistry; he published more than 300 papers on mineralogical subjects (including those on the analysis of rocks and meteorites); he first established the presence and the relationship of the ferrous and ferric iron in the group of the augites and hornblendes; he was the first to accept Tschermak's theory of the felspar group; and his laborious analyses ranged over about two-thirds of the mineral kingdom; he was strongly opposed to Penfield's views on the mutual replacement of fluorine and hydroxyl. Rammelsberg's active labours in mineral chemistry continued to the end of his long life, and at the age of 82 he published an elaborate supplement to his *Handbuch der Mineralchemie.* He died on December 28th, 1899, at Gross Lichterfelde, near Berlin, after a life of almost unexampled industry.

On the motion of Dr. HUGO MÜLLER, seconded by Professor M'LEOD, a vote of thanks was passed to Professor Miers for his Lecture.

December 20th, 1900. Professor THORPE, C.B., F.R.S., President, in the Chair.

The following certificates were read for the first time: Messrs. Merrick William Burrows, Dunkirk, Devizes; Robert Waley Cohen, 11, Hyde Park Terrace, London, W.; Reginald Williams Ferguson, 8, Havelock Terrace, Paisley Road, Glasgow; John Lloyd Thomas Jones, United Service Club, Calcutta; James Menzies, 39, Winterbrook Road, Herne Hill, London, S.E.; Arthur W. Nunn, 313, Sydenham Road, Sydenham, S.E.; Herbert Kilburn Scott, P.O. Box 634, Rio de Janeiro, Brazil; Albert Edward Thomas, 34 South Road, Kingswood, Bristol.

Of the following papers, those marked * were read :—

*169. "On the union of hydrogen and chlorine." By J. W. Mellor, B.Sc.

At the suggestion of Professor H. B. Dixon the author undertook to investigate the mode in which light brings about the combination of hydrogen with chlorine. The electrolysis of hydrochloric acid and of the solution of chlorine in this acid were first studied, as an exact knowledge of these is necessary to interpret the work of previous investigators.

Bunsen and Roscoe state that under certain conditions the gas resulting from the electrolysis of hydrochloric acid consists of a practically pure mixture of hydrogen and chlorine. The author finds, however, that under the most favourable conditions oxygen is present to the extent of 0·009 per cent.

In order to find out if the distribution of the gases in Bunsen and Roscoe's insolation vessel is affected by the absorption of hydrogen chloride, a more complete investigation was made. By plotting the respective amounts of chlorine and hydrogen chloride in the solution, it is found that two distinct and intersecting curves appear: (1) If the hydrochloric acid be less than one-fifth of normal strength, the amount of chlorine absorbed decreases as the amount of hydrogen chloride increases. The explanation is based on Jakowkin's work on the distribution ratio of chlorine between water and carbon tetrachloride where the action of chlorine on water (in darkness) is shown to be a trimolecular one

$$Cl_2Aq \rightleftarrows (\overset{+}{H} + \overset{-}{Cl} + HOCl)Aq.$$

The number of $\overset{+}{H}$ and $\overset{-}{Cl}$ ions is evidently increased by the addition of hydrogen chloride, and therefore, in agreement with Nernst's distribution law, the number of ions derived from the chlorine is diminished. This involves a decrease in the solubility of that gas.

(2) If the strength of the solutions of hydrochloric acid be greater than one-fifth of the normal the amount of chlorine (λ) absorbed *increases* as the amount of hydrogen chloride (p) increases.

The increase is a linear function of the amount of hydrogen chloride present. $\lambda = 0{\cdot}07p + 1{\cdot}528$.

The phenomenon is probably due to the formation of a compound of hydrogen chloride with the chlorine, say HCl_3. There is no sharply defined point of transition, because the phases $\overset{+}{H} + \overset{-}{Cl} + HCl_3$, &c., coexist in the solution.

A slight contraction occurs when chlorine and hydrogen chloride gases are allowed to diffuse into each other.

*170. "The nitration of the three tolueneazophenols." By J. T. Hewitt and J. H. Lindfield.

The three tolueneazophenols have been nitrated by warm dilute nitric acid, and in each case the nitro-group has been found to enter the phenol nucleus in the ortho-position relatively to the hydroxyl. This agrees with the results previously obtained in the cases of oxyazobenzene and benzeneazosalicylic acid.

The following substances were described : o-*Tolueneazo*-o-*nitrophenol*, m. p. 146°; the *ethyl ether*, m. p. 93°; the *acetate*, m. p. 120·5°; the *benzoate*, m. p. 132°.

m-*Tolueneazo*-o-*nitrophenol*, m. p. 128·5°; the *ethyl ether*, m. p. 92°.

p-*Tolueneazo*-o-*nitrophenol*, m. p. 147°; the *ethyl ether*, m. p. 116°; the *acetate*, m. p. 94°; the *benzoate*, m. p. 129°.

The conditions under which *m*-tolueneazo-*o*-nitrophenol can be acetylated or benzoylated have not been discovered, as excess of benzoyl chloride fails to change the substance. The other acylations take place easily and normally. It is also noteworthy that difficulty is experienced in alkylating *o*-tolueneazo-*o*-nitrophenol with sodium ethoxide and ethyl bromide; the other alkylations are, however, normal.

The *ethyl ether* of *benzeneazo*-o-*nitrophenol* was prepared for purposes of comparison; it melts at 93°.

DISCUSSION.

Dr. GEORGE YOUNG inquired what evidence there was to show that acetylisation of a hydroxyazo-compound always produced an acetoxy- and not an acethydrazone derivative. It seemed curious that a change of position of a methyl group in the benzene should influence the acetylisation of the phenol side of the molecule.

Dr. HEWITT, stated that though Goldschmidt claimed to have completely reduced the acetyl derivative of benzeneazo-*p*-cresol to acetanilide and *p*-cresol, MacPherson had obtained compounds by the action of benzoylphenylhydrazine on quinones which were isomeric and not identical with the benzoyl derivatives of the azophenols. Hence it would appear that the acetyl and benzoyl derivatives of the azophenols are true oxygen ethers.

*171. "The brominationof the ortho-oxyazo-compounds and its bearing on their constitution." By J. T. Hewitt and H. A. Phillips.

The effect of substituting agents on numerous oxyazo-compounds of the *para*-series has been studied by one of the authors of this communication and his pupils. So far, bromination or nitration of *ortho*-oxyazo-compounds has not been examined, but it was expected that such compounds would behave as *ortho*quinone-hydrazones, and substitute in the nucleus which had been derived from the diazotised aromatic base. Thus benzeneazo-*p*-cresol was expected to give *para*- or *ortho*-bromobenzeneazo-*p*-cresol, whereas experiment has shown that when the substance is dissolved in glacial acetic acid with an excess of sodium acetate and then brominated, benzeneazo-*o*-bromo-*p*-cresol results. Ortho-oxyazo-compounds appear thus to react towards bromine as true oxyazo-compounds.

In the course of this investigation, the following compounds have been prepared and their properties examined :

*Benzeneazo-*o*-bromo-*p*-cresol*, m. p. 123°; *benzeneazo-*o*-bromo-*p*-cresyl acetate*, m. p. 83°; *benzeneazo-*o*-bromo-*p*-cresyl benzoate*, m. p. 110°; o-*bromobenzeneazo*-p-*cresol*, m. p. 116°; o-*bromobenzeneazo*-p-*cresyl acetate*, m. p. 85; o-*bromobenzeneazo*-p-*cresyl benzoate*, m. p. 106·5°; m-*bromobenzeneazo*-p-*cresol*, m. p. 112°; m-*bromobenzeneazo*-p-*cresyl acetate*, m. p. 61—62°; m-*bromobenzeneazo*-p-*cresyl benzoate*, m. p. 94°; p-*bromobenzeneazo*-p-*cresol*, m. p. 147°; p-*bromobenzeneazo*-p-*cresyl acetate*, m. p. 123°; p-*bromobenzeneazo*-p-*cresyl benzoate*, m. p. 112°.

172. "On the use of pyridine for molecular weight determinations by the ebullioscopic method." By William Ross Innes.

The author described the precautions necessary to obtain accurate results. The constant for pyridine is 29·5.

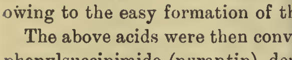
Acids, alcohols, and phenols were shown to give normal molecular weights. Pyridine, therefore, does not favour the association of dissolved substances.

173. "The influence of the methyl group on ring formation." By A. W. Gilbody and C. H. G. Sprankling.

The authors have prepared and analysed *p*-ethoxyphenylsuccinamic acid and the following alkyl substituted derivatives. (1) p-*ethoxyphenylsuccinamic acid,* m. p. 166—167°; (2) *methyl*-p-*ethoxyphenylsuccinamic acid,* m. p. 149—150°; (3) as-*dimethyl* p-*ethoxyphenylsuccinamic acid,* m. p. 160—161°; (4) trans-s-*dimethyl*-p-*ethoxyphenylsuccinamic acid,* m. p. 184—185°; (5) cis-s-*dimethyl*-p-*ethoxyphenylsuccinamic acid;* m. p. 155—156°; (6) *trimethyl*-p-*ethoxyphenylsuccinamic acid,* m. p. 128—129°; (7) iso*propyl*-p-*ethoxyphenylsuccinamic acid,* m. p. 151—152°.

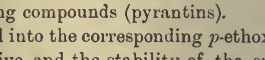
Two forms of the asymmetrically substituted acids should exist according to theory, but only one has been observed during the research. The anilides of the corresponding phenylsuccinamic acids also seem to behave in a similar manner, for previous investigators have found only one acid, where two might be expected.

The scanty evidence at our disposal (Blaise, *Compt. rend.*, 1898, 126, 753) tends to show that of the two formulæ for methyl-*p*-ethoxyphenylsuccinamic acid, for example,



$$\begin{array}{l} CH_3\cdot CH\cdot CO_2H \\ \quad\;\; | \\ \quad CH_2\cdot CO\cdot NH\cdot C_6H_4OC_2H_5 \end{array}$$

and



$$\begin{array}{l} \qquad\quad CH_2\cdot CO_2H \\ \qquad\quad | \\ CH_3\cdot CH\cdot CO\cdot NH\cdot C_6H_4OC_2H_5, \end{array}$$

the former is the correct one.

Under the conditions employed, the lower members of the series readily yielded anhydrous sodium salts, but the salts of the trimethyl- and isopropyl- "aminic" acids have not so far been obtained pure, owing to the easy formation of the ring compounds (pyrantins).

The above acids were then converted into the corresponding *p*-ethoxyphenylsuccinimide (pyrantin) derivative and the stability of the substituted succinimide ring so produced estimated according to the well-known equation, $\frac{I}{T}\cdot\frac{X}{A-x}=Ac$; the figures given being the mean of two or more determinations (compare Miolati and Longo, *Att. Accad. Lincei Rend.*, 1894, [v], 3, 515, 597; 1895, [v], 4, 351; Miolati and Lotti, 1896, [v], 6, 88; Piutti, *Ber.*, 1896, 29, 85).

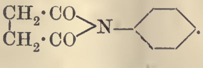
It was necessary to carry out the experiments in alcoholic solution because of the insolubility of the substances in water.

Pyrantin	m. p. 155°	Ac = 0·0949
Methylpyrantin	......m. p. 105—106°	Ac = 0·1831
as-Dimethylpyrantin	m. p. 70—71°	Ac = 0·0872
cis-s-Dimethylpyrantin	m. p. 114—115°	Ac = 0·1393
Trimethylpyrantin.	m. p. 87—88°	Ac = 0 0446
*iso*Propylpyrantin.	m. p. 98—99°	Ac = 0·1432

The stability constant was determined for phenylsuccinimide in both aqueous and alcoholic solution, in order to compare the results obtained with those of Miolati for the tolyl- and xylyl-succinimides in aqueous solution.

Phenylsuccinimide was found to be 40·03 times more stable in alcoholic than in aqueous solution, and a correction had also to be made for the value of the ethoxyl group which decreased the stability in alcoholic solution 1·704 times.

The results can then be calculated and tabulated, for the methyl substituted phenylsuccinimides.



	Ac found. Pyrantin in alcoholic solution.	**Ac** calculated. Phenylsuccinimide in alcoholic solution divided by 1·704.	**Ac** calculated. Phenylsuccinimide in aqueous solution (G. and S.) multiplied by 40·03 ; or found (Miolati).
Pyrantin	0·0949	0·0557	2·23
Methylpyrantin...........	0·1831	0·1075	4·30
Isopropylpyrantin	0·1432	0·0840	3·36
cis-Dimethylpyrantin ...	0·1393	0·0818	3·27
Phenylsuccinimide...... ..	Mean of both Miolati	& authors' experi	ments. 2·23
as-Dimethylpyrantin.....	0·0872	0·0512	2·05
3 : 5-Xylylsuccinimide ...	—	—	1·145
p-Tolylsuccinimide........	—	—	1·12
m- ,, ...	—	—	1·10
Trimethylpyrantin........	0·0446	0·0262	1·05
2 : 5-Xylylsuccinimide ...	—	—	0·88
o-Tolylsuccinimide........	—	—	0·856
2 : 3-Xylylsuccinimide ...	—	—	0·815
2 : 6- ,, ...	—	—	0·16

A glance at the above table easily shows in how great a degree the stability of the succinimide ring can be decreased by the introduction of methyl groups into the fatty ring, whereas Miolati's experiments prove that the introduction of methyl groups into the aromatic nucleus increase the stability.

Substances having the constitution formulated above but containing methyl groups in both rings do not appear to have been prepared, although the list given is long enough to anticipate the result which might be expected in such cases.

The reason the authors chose the pyrantins and calculated the results was that they might obtain some information about the antipyretic action of the methyl group, but unfortunately the substances obtained proved so insoluble in water that no definite result has been obtained.

174. "Experiments on the production of optically active compounds from inactive substances." By F. Stanley Kipping, Ph.D., D.Sc., F.R.S.

The note by Cohen and Whiteley under the above title (this vol., p. 212) deals with experiments which are very similar to some in which the author, assisted by Mr. Hunter, has been recently engaged, the results of which it thus becomes desirable to place on record.

Guided by practically the same considerations, and working with the same object as Cohen and Whiteley, attempts have been made to prepare directly unequal quantities of two enantiomorphously related substances by synthesising an asymmetric carbon group in presence of, or in combination with, some optically active compound, in the hope that the latter would have some directive action on the atoms or groups entering into combination.

Among those experiments in which an optically active substance was used merely as a medium in which the synthesis took place, mention may be made of the preparation of benzoin by the action of potassium cyanide on benzaldehyde in a concentrated alcoholic solution of camphor; mandelic nitrile was also prepared from benzaldehyde and hydrogen cyanide in an alcoholic solution of camphor and then hydrolysed with hydrochloric acid; pyruvic acid and methyl ethyl ketone were also separately reduced in concentrated glucose solution. The results were negative in all these cases.

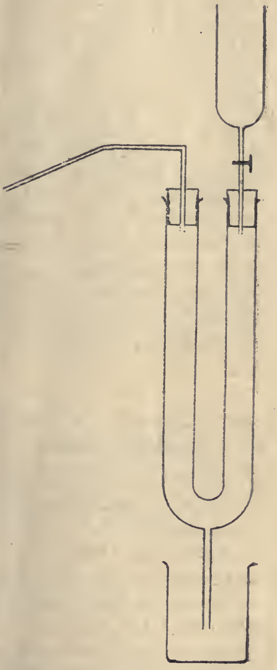
Among the experiments in which the optically active substance was combined with the inactive nucleus the following may be noted. The reduction of quinine pyruvate and of quinine lævulinate with sodium amalgam or aluminium amalgam; the reduction of *bornyl pyruvate* (b. p. 149—150°, 15 mm.); the reduction of the *oxime* (m. p. about 90°) of bornyl pyruvate, and the reduction of bornyl lævulinate (b. p. 170—171°, 20—25 mm.). After eliminating the original optically active base or alcohol, the product, namely, lactic acid, α-amidopropionic acid, or γ-hydroxyvaleric acid (as lactone), as the case might be, was found to be inactive.

Owing to its low specific rotation and the difficulty of isolating it, the experiments in which lactic acid was obtained are by no means satisfactory, and mandelic acid, which has a high specific rotation, was therefore prepared by the reduction of *bornyl benzoylformate*; this ethereal salt separates from light petroleum in crystals melting at about 78°, and is reduced to the corresponding hydroxy-salt by sodium amalgam in presence of a little acetic acid; after hydrolysis with potash, it gave inactive mandelic acid.

The failure of these experiments may be caused by racemisation taking place during hydrolysis of the original product, and this possibility is being investigated; even the apparently strong evidence obtained by combining these results with those of Cohen and Whiteley can hardly be considered to settle the question as to the possibility of directly synthesising *unequal* quantities of enantiomorphously related forms, in view of the actual results obtained in the case of the sugars and the theoretical conclusions by which they may be supported.

175. "A lecture table experiment for the preparation of nitric oxide." By Alfred Senier.

When nitric oxide is prepared by the interaction of copper and diluted nitric acid in a flask in the ordinary way, a difficulty arises owing to the accumulation of water. This gives rise to the formation of a large proportion of nitrous oxide. By employing concentrated nitric acid and an excess of copper in the apparatus shown this may be obviated. The figure explains itself. In the apparatus employed the U-tube has a diameter of 3 cm., and together with the small tube beneath measures 36 cm. in height. The larger tube is loosely packed with copper turnings, water is put into the beaker below, and nitric acid (68 per cent.) is dropped from the stoppered funnel. Each drop of acid acts on the copper, liberating nitric oxide, while a solution of cupric nitrate and dilute nitric acid passes into the beaker. The gas after ascending the second arm of the U-tube is quite colourless, and contains only traces of nitrous oxide as shown by absorption with ferrous sulphate.



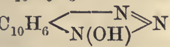
176. "The action of ethylene dibromide on xylidine and pseudocumidine." By Alfred Senier and William Goodwin.

The reaction between ethylene dibromide and aniline originally studied by Hofmann, and extended to homologues of both compounds by subsequent observers, has been applied to xylidine and pseudocumidine. Dixylylethylenediamine and dicumylethylenediamine were obtained, together with their related piperazines. From the diamines, derivatives were prepared homologous with those obtained by Mills (*Trans.*, 1900, **77**, 1020). *Dixylylethylenediamine*, $C_2H_4(NHC_6H_3Me_2)_2$, white, feathery crystals, m. p. 74—75°. *Dixylylethylenediamine nitrate*, $C_2H_4(NHC_6H_3Me_2)_2(HNO_3)_2$, m. p. 166°. *Dixylylethylenediamine platinichloride*, $C_2H_4(NHC_6H_3Me_2)_2(HCl)_2,PtCl_4$, bright yellow crystals. *Dixylylethylenediamine mercurichloride*, $C_2H_4(NHC_6H_3Me_2)_2HgCl_2$, pale yellow crystals, m. p. about 118°. *Tetranitrodixylylethylenediamine*, $C_2H_4[NHC_6H(NO_2)_2Me_2]_2$, pale yellow crystals, m. p. 220°. An *isomeride*, m. p. 52—53°. *Mononitrodixylylethylenediamine*, m. p. 152—154°, and a *trinitro*-derivative, m.p. 191—192°. *Dixylylpiperazine*, $Me_2H_3C_6N(C_2H_4)_2NC_6H_3Me_2$, consists of shining, white leaflets, m. p. 151°. *Dipseudocumylethylenediamine*, $C_2H_4(NHC_6H_2Me_3)_2$, brilliant, colourless needles, m. p. 168°. *Dipseudocumylethylenediamine nitrate*, $C_2H_4(NHC_6H_2Me_3)_2(HNO_3)_2$, colourless needles, m. p. 154°. *Dipseudocumylethylenediamine platinichloride*, $C_2H_4(NHC_6H_2Me_3)_2(HCl)_2PtCl_4$, buff-coloured powder. *Dipseudocumylethylenediamine mercurichloride* $C_2H_4(NHC_6H_2Me_3)_2HgCl_2$, crystals melting at 150°. *Dinitrodipseudocumylethylenediamine*, $C_2H_4[NHC_6H(NO_2)Me_3]_2$, yellow powder, m. p. 97—98°; an *isomeride*, m. p. 49—50°. *Dipseudocumylpiperazine*, $Me_3H_2C_6N(C_2H_4)_2NC_6H_2Me_3$, colourless needles, m. p. 148—150°.

177. "The action of phenyl carbimide on diphenyl-, dialphyl-, and dinaphthyl-diamines." By Alfred Senier and William Goodwin.

When the two ethylenediamines described in the preceding abstract were treated with phenyl carbimide an interesting reaction resulting in the formation of ethylenediamines of the type $C_2H_4(NR'\cdot CO\cdot NHPh)_2$ was brought to light. These diamines are analogous to the ethylenediamine of Volhard (*Ann.*, 1861, **119**, 349), and to the trimethylene carbanilide of Hanssen (*Ber.*, 1887, **20**, 783). The reaction is shown to be a general one by the formation of the following homologues:—*Dicarbanilido-diphenyl-ethylenediamine*, $C_2H_4(NPh\cdot CO\cdot NHPh)_2$, m. p. 220°. *Dicarbanilido-ditolyl ethylenediamines*, $C_2H_4(NC_6H_4Me\cdot CO\cdot NHPh)_2$. The *ortho*-derivative melts at 195—196°, the *meta-* at 181·5°, and the *para-* at 186°. *Dicarbanilido-dixylylethylenediamine*, $C_2H_4(NC_6H_3Me_2{\cdot}CO{\cdot}NHPh)_2$, melts at 167°. *Dicarbanilido-dipseudocumylethylenediamine*, $C_2H_4(NC_6H_2Me_3{\cdot}CO{\cdot}NHPh)_2$, m. p. 191°. *Monocarbanilidodi-α-naphthylethylenediamine*, $C_2H_4(NHC_{10}H_7)(NC_{10}H_7{\cdot}CO{\cdot}NHPh)$, m. p. 266°.

178. "Note on the action of nitrous acid on β-nitroso-α-naphthylamine." By Arthur Harden and J. Okell.

When β-nitroso-α-naphthylamine is treated in alcoholic solution with potassium nitrite and hydrochloric acid, it yields a potassium salt, $C_{10}H_6O_2N_3K$, which crystallises in reddish-coloured needles and decomposes vigorously at 250°. A different salt, described in a previous paper (*Ann.*, 1889, **255**, 148) was obtained by this reaction, which had the formula $C_{10}H_6O_4N_4KH$, and crystallised with $1\frac{1}{4}H_2O$, but on repeating the experiments the exact conditions necessary for the formation of this salt could not be ascertained, and the simpler salt, which differs from it by the elements of nitrous acid, was always obtained. Sodium nitrite yields the corresponding salt, $C_{10}H_6O_2N_3Na$. These salts behave towards acids in a manner similar to that already described, yielding, with hydrochloric acid and stannous chloride, a compound, $C_{10}H_6N_3{\cdot}OH$, which probably has the constitution of an imidazole,  $C_{10}H_6{<}\begin{matrix}\overline{\quad\;\; N}\\ N(OH)\end{matrix}{>}N$ (compare Zincke and Schwarz, *Ann.*, 1900, **311**, 329). This substance crystallises with $1H_2O$, decomposes violently at 222°, and acts as an acid, yielding crystalline salts of sodium, potassium and barium. The silver salt has the formula $C_{10}H_6{\cdot}N_3OAg$, and not that previously ascribed to it. The acetate melts at 109°, and the silver salt yields colourless, crystalline derivatives when heated with methyl and ethyl iodides.

The isomeric α-nitroso-β-naphthylamine behaves towards nitrous acid in a similar manner, yielding a potassium salt, $C_{10}H_6N_3O_2K + H_2O$, which, with hydrochloric acid and stannous chloride, gives a compound, $C_{10}H_6N_3{\cdot}OH$, which decomposes at 245°, and is isomeric with that described above, which it closely resembles in its properties.

179. "1:2:4-Metaxylidine-6-sulphonic acid." By Henry E. Armstrong and L. P. Wilson.

One of the authors has on previous occasions discussed the conditions under which either ortho- or para- or meta-derivatives are formed from benzenoid amines, and has argued that meta-derivatives are produced by the direct attack of the benzene nucleus, whilst ortho- and para-compounds are formed by a process of isomeric change in which the radicle is transferred from the nitrogen into the nucleus. An opportunity of further testing this generalisation is afforded by 1 : 2 : 4-metaxylidine. When sulphonated by an excess of fuming acid, this is readily converted into the 5-sulphonic acid, the only metaxylidinesulphonic acid hitherto described; it was to be supposed that the 6-sulphonic acid would be readily obtained on heating the sulphate, and this proves to be the case.

When metaxylidine is mixed with a single molecular proportion of 100 per cent. sulphuric acid, and the mixture heated at 185° to 195° during 6 hours, the product then dissolved in water, and the solution neutralised with potassium carbonate, 90 per cent. of the theoretical amount of *potassium*-1 : 2 : 4 : 6-m-*xylidinesulphonate*, $C_6H_2(CH_3)_2(NH_2)\cdot SO_3K$, is obtained. *Potassium*-1 : 2 : 4 : 6-*aceto*-m-*xylidinesulphonate*, $C_6H_2NH(CH_3)_2Ac\cdot SO_3K$, is obtained by heating the potassium sulphonate with acetic anhydride. It is a colourless substance crystallising from alcohol in spindle-shaped needles. On adding bromine to its solution in water, the sulphonic group is not affected, although it is easily displaced from the unacetylated acid.

Potassium-1 : 3 : 5-m-*xylenesulphonate*, $C_6H_3(CH_3)_2\cdot SO_3K,\frac{1}{2}H_2O$, is obtained from the 1 : 2 : 4 : 6-*m*-xylidinesulphonate by diazotising, and then boiling with alcohol, or by means of the hydrazine; it crystallises from water in thin, colourless, lustrous leaves, and is nearly insoluble in alcohol. On fusing this salt with potash, it is converted into 1 : 3 : 5-*m*-xylenol, m. p. 65°. *Barium*-1 : 3 : 5-m-*xylenesulphonate*, $(C_6H_3Me_2\cdot SO_3)_2Ba,2H_2O$, crystallises from water in fine, colourless leaves. 1 : 3 : 5-m-*Xylenesulphonic acid* crystallises from water in thin, transparent, flattened needles. 1 : 3 : 5-m-*Xylenesulphochloride*, $C_6H_3(CH_3)_2\cdot SO_2Cl$, crystallises from light petroleum and benzene in needles, and from chloroform in massive crystals; m. p. 94°. 1 : 3 : 5-m-*Xylenesulphobromide*, $C_6H_3(CH_3)_2\cdot SO_2Br$, resembles the sulphochloride in crystalline behaviour; m. p. 92—93°. 1 : 3 : 5-m-*Xylenesulphonamide*, $C_6H_3(CH_3)_2\cdot SO_2NH_2$, crystallises from water in very lustrous, colourless flakes, and from benzene in very fine needles; m. p. 134°. 1 : 3 : 5-m-*Xylenesulphanilide*, $C_6H_3(CH_3)_2\cdot SO_2\cdot NH\cdot C_6H_5$, crystallises from alcohol in large, monosymmetric crystals; m. p. 119°.

$$a : b : c = 0{\cdot}8718 : 1 : 0{\cdot}7341. \quad \beta = 110°58'.$$

1 : 3 : 5-m-*Xylenesulpho*-p-*toluidide*, $C_6H_3(CH_3)_2\cdot SO_2NH\cdot C_6H_4\cdot CH_3$, crystallises from alcohol in monosymmetric crystals resembling the anilide; m. p. 121—122°.

$$a : b : c = 1{\cdot}18195 : 1 : 0{\cdot}9380. \quad \beta = 101°7'.$$

180. "The preparation of acetylchloraminobenzene and related compounds." By F. D. Chattaway and K. J. P. Orton.

The authors reply to Armstrong's recent criticism of the authors' work. The statements which he calls in question are proved to be correct, and details are given of the method of preparing acetylchloraminobenzene. It is also shown that acetylchloramino-2 : 4-dichlorobenzene can be obtained by the direct action of chlorine on acetanilide.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Brühl, J. W., E. Hjelt, und O. Aschan. Die Pflanzenalkaloide. Ill. Braunschweig 1900. From the Publishers.

Gowland, W. Remains of a Roman silver refinery at Silchester (from *Archæologia*, vol. 57) 1900. From the Author.

Idris, T. H. W. Notes on essential oils. Second edition. London 1900. From the Author.

Ramsay, William. Modern chemistry. Part I. Theoretical. Part II. Systematic. London 1900. From the Publishers.

Rudorf, George. The periodic classification and the problem of chemical evolution. London 1900. From the Publishers.

II. *By Purchase.*

Glaser, Fritz. Indikatoren der acidimetrie und alkalimetrie. Wiesbaden 1901.

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At the next meeting, on Thursday, January 17th, 1901, the following papers will be communicated :—

"The preparation of esters from other esters of the same acid." By T. S. Patterson and Cyril Dickinson.

"Tecomin. A colouring matter derived from *Bignonia tecoma*." By T. H. Lee.

"A new method for the measurement of ionic velocities in aqueous solution." By B. D. Steele, B.Sc.

A LIST

OF THE

OFFICERS AND FELLOWS

OF

THE

CHEMICAL SOCIETY.

CORRECTED TO MARCH, 1900.

BURLINGTON HOUSE,
LONDON, W.

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ELECTED IN 1900.

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A. J. GREENAWAY.

ASSISTANT SECRETARY AND LIBRARIAN.

ROBERT STEELE, F.S.A.

THE CHEMICAL SOCIETY.

THE Chemical Society was founded February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice of the same from the Secretaries.

Every Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications issued during the period of his continuing a Fellow. Fellows are also entitled to the use of the books in the Society's collection, under such restrictions as the Council may deem necessary. They have the privilege of introducing two visitors to Ordinary Meetings of the Society, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

Every Fellow, previous to his admission, is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due on the first day of January of every year. The life composition fee is £30. Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If, however, a Candidate be elected during the month of November or December, he is not called upon to pay any annual subscription for the current year, and is not entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March shall owe two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, ceases to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

PUBLICATIONS OF THE SOCIETY.

The following is a list of the Publications of the Society:

Memoirs and Proceedings, 1841—47, 3 vols.
Quarterly Journal, 1848—62, 14 vols.
Journal, 1863—
Proceedings, 1885—

The Journal and Proceedings are sold to non-Fellows of the Society at a price of £2 and 7/6 per annum respectively. The Society has also issued General Indexes to its publications, 1841—72, price 3/-; 1873—82, price 16/- (11/-, post free, to Fellows); 1883—92, price 21/- (16/-, post free, to Fellows); and the Jubilee Volume, 1891, price 6/-.

The Journal, which is issued monthly, contains papers communicated to the Society, Memorial Lectures on the life and work of eminent foreign Fellows deceased, together with abstracts of all papers relating to chemistry and closely connected branches of science published in other journals, British and foreign.

The Proceedings contains a short report of the business at each meeting, and abstracts of all papers presented to the Society. It is usually published within seven days after the meeting. It serves as a medium of publication, not only for the abstracts of papers which subsequently appear in full in the Journal, but also for the publication of short papers and preliminary communications.

COMMUNICATION OF PAPERS.

No announcement of papers can be made until the papers have been received by the Secretaries, and no title can be included in the list of papers to be brought before a meeting of the Society, unless the paper and an abstract of it are in the hands of the Secretaries at least three days before the date of the meeting. All papers submitted to the Society, with their illustrative drawings, become the property of the Society, unless stipulation be made to the contrary. Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. The Committee meets twice a year to consider applications for grants, and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

At the last Annual Meeting, March 29th, 1900, the numerical strength of the Society was as follows: 2,292 Fellows, 33 Foreign Members.

HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. S., Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath, Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich, Germany
Mar. 1, 1860	Berthelot, Prof. M., Membre de l'Institut, F.R.S., Collège de France, Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. S., F.R.S., Reale Università, Rome
Feb. 1, 1883	Cleve, Prof. Dr. P. T., Universitet, Upsala, Sweden
Jan. 20, 1898	Curtius, Geh. Rath, Prof. Dr. T., Universität, Heidelberg, Germany
Feb. 1, 1883	Erlenmeyer, Prof. Dr. E., Aschaffenburg, Germany
June 16, 1892	Fischer, Geh. Rath, Prof. Dr. Emil, F.R.S., Dorotheenstr. 10, Berlin
Feb. 1, 1883	Fittig, Prof. Dr. R., Universität, Strassburg, Germany
Jan. 20, 1898	Franchimont, Prof. Dr. A. P. N., Rapenburg 104, Leyden, Holland
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Université, Geneva
Feb. 2, 1888	Hoff, Prof. Dr. J. H. van't, F.R.S, Uhlandstrasse 2, Charlottenburg, Berlin
Jan. 20, 1898	Körner, Prof. W., R. Scuola superiore d'agricoltura, Milan, Italy
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath, Prof. Dr. A., Kaiser Wilhelmstrasse 43, Breslau, Germany
Feb. 2, 1888	Landolt, Prof. Dr. H., Albrechtstrasse 14, Berlin, N.W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Wasagasse 9, Vienna
Jan. 20, 1898	Markownikoff, Prof. Dr. W., Universität, Moscow
Feb. 1, 1883	†Mendeléeff, Prof. Dr. D. I., F.R.S., 19 Zabalkansky, St. Petersburg
Jan. 20, 1898	Menschutkin, Prof. Dr. N., Universität, St. Petersburg
Jan. 20, 1898	Moissan, Prof. Henri, Rue Vauquelin 7, Paris
Jan. 20, 1898	Ostwald, Prof. Dr. W., Linnéstrasse 2/3, Leipzig, Germany
Jan. 20, 1898	Raoult, Prof. F. M., Rue des Alpes 2, Grenoble, France
Jan. 20 1898	Remsen Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.

* Faraday Lecturer, 1872.

† Faraday Lecturer, 1889

Date of Election.	
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Th., Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. W., Rue Beckmann 32, Liége, Belgium
May 18, 1876	Thomsen, Prof. Dr. Julius, Universitet, Copenhagen
Jan. 20, 1898	Troost, Prof. L. J., Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. J. D. van der, T.C., Hooftstraat 117, Amsterdam
Feb. 2, 1888	Wislicenus, Geh. Rath, Prof. Dr. Johannes, F.R.S., Liebigstr. 18, Leipzig Germany

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1869.	J. B. A. Dumas.
1872.	S. Cannizzaro.
1875.	A. W. von Hofmann.
1879.	A. Wurtz.
1881.	H. von Helmholtz.
1889.	D. Mendeléeff.
1895.	Lord Rayleigh.

LONGSTAFF MEDALLISTS.

1881.	T. E. Thorpe.
1884.	C. O'Sullivan.
1888.	W. H. Perkin.
1891.	F. R. Japp.
1894.	H. T. Brown.
1897.	W. Ramsay.
1900.	W. H. Perkin, junr.

Any inaccuracies in this list should be reported to The Secretaries, Chemical Society, Burlington House.

NAMES OF FELLOWS.

|| Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society ; V.P. as Vice-President ; S. as Secretary ; T. as Treasurer ; F.S. as Foreign Secretary ; P. as President.

Date of Election.			
1898			Abbott, Albert, B.A., Church Street, Adlington, Chorley, Lancs.
1848	Trans.	C. 1856-9 62-5 V.P. 66-7 F.S. 68-9 T. 69-75 P. 75-7	Abel, Sir F. A., Bart., K.C.B., D.C.L., F.R.S., 2, Whitehall-court S.W., and the Imperial Institute, Imperial Institute-road, London, S.W.
1871	Trans.	C. 1882-3	Abney, Sir W. de W., Capt., R.E., K.C.B., D.C.L., F.R.S., F.R.A.S., F.R.G.S., Rathmore Lodge, Bolton-gardens South, S.W.
1883			Abraham, Alfred C., 87, Bold Street, Liverpool
1890			‖Abrines, G. Anthony, Waterport-Street, Gibraltar
1897	Trans.		Ackroyd, William, F.I.C., 9, Grandsmere Place, Halifax, Yorks.
1875	Trans.		Acworth, Joseph John, Ph.D., F.I.C., Braeside, Shootup Hill, Cricklewood, N.W.
1892			Adams, Arthur, Kelvin House, Edgbaston-road, Smethwick
1888			Adams, Charles M., Albany-buildings, Lord-street, Southport
1877	Trans.		‖Adams, M. A., F.R.C.S., the Kulm, Bearstead, near Maidstone
1892			Adcock, Samuel Robert, 16 Lithos Road, Hampstead, N.W.
1896			Addie, Robert, c/o The Smelting Corporation, Ltd., Ellesmere Port, Cheshire.
1889	Trans.		Addyman, F. Thornton, St. George's Hospital, Hyde Park, S.W.
1881	Trans.		Adeney, W. E., D.Sc., Royal University of Ireland, Earlsfort Terrace, Dublin
1899			Aders, R. H., Pension Huguenin, Rue Levrie, Geneve, Switzerland
1885	Trans.		Adie, R. Haliburton, B.Sc., M.A., 8, Richmond-road, Cambridge
1885			Adriance, John S., 321, Lexington-avenue, New York, U.S.A.
1885			Aikman, Charles M., M.A., B.Sc., F.R.S.E., F.I.C., 128, Wellington-street, Glasgow
1879			Albright, G. Stacey, The Elms, Edgbaston-park-road, Edgbaston, Birmingham
1893			Albuquerque, John Predozod de, Barbados, West Indies
1885			Alcock, Frank Harris, 9, Broad-street Corner, Birmingham
1892			Alcock, John W. Central Brewery, 45, Mott-street, Birmingham

Date of Election.		
1888		Alexander, John, M.A., Midfield, Perth
1897		Alexander, J. O., 11, Avenue Road, South Norwood Park, S.E.
1882		Alford, Henry James, M.D., 1, Hovelands-terrace, Taunton
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, Salford Sugar Refinery, and 57, Mabfield Road, Fallowfield, Manchester
1864	Trans.	‖Allen, Alfred Henry, 8, Broomfield-road, Sheffield
1894		Allen, F. J., Phœnix Chemical Works, Upper North-st., Poplar, E.
1891		Allen, George James, Chemical Laboratory, 55 and 56, Barton Arcade, Manchester
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1894	Trans.	Allhusen, F. E., Harrow School, Harrow
1898		Allhusen, E. L., B.Sc., Beadnell Tower, Chathill, Northumberland
1894		Allibon, G. H., 30, Donegal-place, Belfast
1894		Allport, J., M.A., Sunnyside House, Festiniog, North Wales.
1890		Allsom, Edward W., L.R.C.P., L.R.C.S., C.M.Ed., C.F.P.S.Glas., L.A.H.D., and P.S.I.
1899		Allworthy, J. H., Paston Grammar School, North Walsham, Norfolk
1899		‖Allworthy, S. W., M.A., M.D., The Manor House, Antrim Road, Belfast.
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. Oxon., M.R.I., 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc., 65 Palace Gardens Terrace, Bayswater, W.
1895		Anderson, H., Taunton College, Taunton
1900		Anderson, J. W., 1, Preston Villas, Halling, Kent
1892		Anderson, William Smellie, 55, York Place, Edinburgh
1888		Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882		Andrews, L. W., Ph.D., The University, Iowa City, Iowa, U.S.A.
1870		Andrews, Thomas, F.R.S., M.I.C.E., Ravencrag, Wortley, near Sheffield
1877		Angell, John, 6, Beacon's Field, Derby-road, Withington, Manchester
1898		Annable, H. W. Coupe-, University College, Sheffield.
1876		Ansdell, Gerrard, 3, Cross-lane, St. Mary-at-Hill, E.C.
1879		Appleby, Herbert, Moorfield Chemical Works, Boothstown, near Manchester
1890	Trans.	Appleyard, James Robert, Royal Technical Institute, Salford
1897		Aquino, T. H., Gadag, Dharwar District, India
1897		Arbuckle, William, 20, Albemarle Street, W.
1884		Archbutt, Leonard, The Yews, Madeley-street, Derby
1875		Armistead, William, M.B., C.M., Stapleford, Cambridge

Date of Election.			
1881			Armitage, Charles, Lancaster Corporation Gas Works, Lancaster
1900	Proc.		Armitage, F. P., High House, Brook Green, Hammersmith, W.
1900			Armstrong, F. W., The Hill, Langport, Somerset
1870	Trans.	C.1873-4 S. 1875-93 P.1893-5	‖Armstrong, Henry E. Prof,, LL.D., Ph.D., F.R.S., 55, Granville Park, Lewisham, S.E., and Central Technical College, Exhibition-road, London, S.W.
1895			Arnot, J. Melrose, The Mill House, Hendon Paper Works, Sunderland
1894			Ashcroft, J. B., Christ Church Schools, Derby
1894			Ashdown, Charles H., F.R.G.S., Monastery-close, St. Alban's
1884			Ashe, William Percy, M.D., 17, Alexander-square, S.W.
1897			Ashworth, J. B., Bridge Cottage, Broad Green, Liverpool
1859	Trans.	C. 1868-71, 82-5, 91-2, V.P.93-6	‖Atkinson, Edmund, Ph.D., Portesbery-Hill, Camberley, Surrey
1899			Atkinson, G. D., c/o Messrs. Crowley & Co., The Brewery, Alton, Hants
1872	Trans.		‖Atkinson, R. W., B.Sc., 44, Loudoun-square, Bute Docks, Cardiff
1862	Trans.	C. 1874-7	‖Attfield, Prof. John, F.R.S., 111, Temple-chambers, E.C., and Ashlands, Watford, Herts
1872	Trans.		‖Attwood, George, F.G.S., A.M.I.C.E., Durmast Lodge, Ringwood, Hants, and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1895	Trans.		‖Auden, H. A., Municipal Technical Institute, Romford-road, West Ham, E.
1886			Audley, James A., B.Sc. Lond, A.R.C.Sc. Lond, F.I.C., 17, Gladstone-place, Hanley
1877			Austen, Peter T., Ph.D., 218, St. John's-place, Brooklyn, N.Y., U.S.A.
1892			Avery, David,
1896			Aykroyd, H. E., Glen Rosa, The Grove, Ilkley, Yorks.
1891			Aylan, John Charles, Manager Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1875	Trans.		‖Bailey, G. H., Ph.D., D.Sc., Owens College, Manchester, and Marple Cottage, Marple, Cheshire.
1895			Bailey, G. P., M.A., Professor of Chemistry, Stonyhurst College, near Blackburn.
1893			Bailey, Henry, 18, Lavender-sweep, S.W.
1898			Bailey, W. M., B.A., 13, Green Lane-road, New Evington, Leicester.
1884			‖Bain, Daniel, United Alkali Co., Allhuisen's Works, Gateshead
1891			Bairstow, John, Burley, Queen's Park, Chester
1889			‖Baker, Charles Frederic, B.Sc., Ph.D., Mason College, Birmingham

Date of Election.			
1883	Trans.		‖Baker, Charles J., The Schools, Shrewsbury
1899			Baker, C. H., Athelney, Featherstone-road, King's Heath, Birmingham
1900			Baker, F. Nolan, Capt., 3rd Royal Inniskilling Fusiliers, Mullingar, Ireland
1881	Trans.		Baker, Harry, Epworth House, Maughland-lane, Runcorn, Cheshire.
1884	Trans.	C. 1899-1900	‖Baker, H. Brereton, M.A., Dulwich College, S.E.
1893	Trans.		Baker, Julian L., Stamford, Hendham-road, Upper Tooting, S.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon, Surrey
1897			Ball, John, Ph.D., F.G.S., A.M.I.C E., Geological Survey Office, Public Works Department, Cairo, Egypt
1897			Ball, William, 54, Stretton-road, Leicester
1892			Ballantyne, Horatio, 75, Chancery-lane, W.C.
1884			Ballard, J. Farrow, Brewery House, Staines, Middlesex
1896			Ballingall, William, Ardarrock, Dundee
1891			Baly, Edward C. Cyril, University College, W.C.
1886			Bamber, H. K. G., c/o Messrs. Knight, Bevan, and Sturge, Northfleet
1890			Bamber, M. Kelway, Hatton, Ceylon.
1896			Banerjee, Gopal Ch., Kaiser Soap Co., Cawnpore, India
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, 59, Tregunter-road, S. Kensington, S.W.
1880			Barclay, Arthur E., 95, Farringdon-street, E.C.
1897			Barclay, John, B.Sc., Avenue Cottage, near Bromsgrove, Worcestershire
1877			Bardsley, J., F.I.C., Church Works, Church, Lancashire
1896			Barker, W. H., B.Sc., The Acton and Chiswick Polytechnic, Bedford Park, W.
1870			Barklie, Robert, Linden Lodge, Jordanstown, Belfast
1894			Barlet, Stéphane, B.Sc., 47, Bassett-road, N. Kensington, W.
1897			Barlow, H. W. L., M.A., M.B., Oxon, Holly Bank, Croftsbank-road, Urmston, Manchester
1897			Barlow, W. H., 152, Osbaldestone-road, Stoke Newington, N.
1897			Barlow, William, The Red House, Stanmore, Middlesex.
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W., and Dynamite Works, Zuurfontein, S.A.R.
1875			‖Barnes, R. L., Phœnix Chemical Works, Hackney Wick, N.E.
1884			Barr, William Henry, M.D., Belgrave-place, Bury
1888			Barraclough, William H., F.I.C., Mortomley, near Sheffield
1895			Barralet, E. S., 88, King Edward's-road, S. Hackney, N.E.
1891			Barratt, J. Treeby, Bronheulog, Mostyn, North Wales

Election.			
1869			Barret, Edward L., B.Sc., 8, Rue Voltaire, St. Germain en Laye, Seine et Oise, France
1892	Trans.		‖Barrows, Arthur Edward, Bloomfield Iron Works, Tipton, Staffordshire
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, J. A., Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc., Ph.D., University of North Carolina, Chapel Hill, N.C.
1897			Bastow, Frank,
1864	Trans.	C. 1870-2, 90-3	‖Bassett, Henry, 26, Belitha-villas, Barnsbury, N.
1891			Bate, William, National Explosives Co., Hayle, Cornwall
1893			Bateman, John, Messrs. J. C. and J. Field, The Marsh, Lambeth, S.E.
1896			Bathurst, Charles, jun., B.A., 3, Stone-buildings, Lincoln's Inn, W.C.
1896			Bay, L. H., The Grammar School, Carlisle
1892			Bayliss, Charles, Ellesmere, Selly Park, near Birmingham
1874			Bayly, F. W., The Royal Mint, E.
1874			‖Bayne, James, Professor, Royal Veterinary College, Camden Town, N.W.
1879			‖Bayne, William Thirlwall, LL.D., Brockhill, Broad Clyst, Exeter
1873			Baynes, James, Ph.D., F.R.M.S., Borough Analyst's Office, Royal Chambers, Scale-lane, Hull
1897			Beadle, A. A., Beadonwell, Belvedere, Kent
1891	Trans.		Beadle, Clayton, Melrose, Hatherley Crescent, Sidcup
1861			‖Beadnell, Major Charles Edward, R.A., Fernside, Redhill, Surrey
1899			Beale, F. J., Wilderspool Brewery, Warrington
1867			Beale, William Phipson, Q.C., 10, New-court, Carey-street, Lincoln's-inn, W.C.; and 25, Sheffield-terrace, Kensington, W.
1899			Bean, Percy, 24, Darwen-street, Blackburn
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, G. Russell, D.P.H. Camb., L.R.C.P. Lond., M.R.C.S. Eng., L.S.A., Warwick House, Upper-street, Islington, N.
1887			Beasley, William C. T., B.A., Fermain, St. Leonards-on-Sea
1890	Trans.		Beck, Charles R., 118, Disraeli-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, c/o Mrs. Tait, Shore-road, Stevenston, Ayrshire, N.B.
1882			Beckett, John Hampden, Corbar Hill House, Buxton, Derbyshire
1879	Trans.	C. 1895-9	Bedson, P. Phillips, Prof., D.Sc., M.A., University College, Newcastle-on-Tyne
1900			Beesley, F. A., B.Sc., Bank House, Wirksworth, Derby
1872	Trans.		‖Beilby, George T., St. Kitts, Slateford, N.B.
1891			Belbin, T. St. J., 101, Piccadilly, W.
1888			Belcher, John Hope, B.A., Technical Institute, Coventry

Date of Election.			
1891			Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester A., B.A., M.B. (Dublin), 3, Mansfield-place, Richmond, Surrey
1889			Bell, E. Wightman, High Bridge, Spalding
1899			Bell, H. P., B.A., 30, Egerton-crescent, S.W.
1865	Trans.		‖ Bell, J. Carter, the Cliff, Higher Broughton, Manchester
1863	Trans.		Bell, Sir I. Lowthian, Bart., F.R.S., Rounton Grange, Northallerton
1889			‖ Bell, Percy Carter, 150, Nassau-street, New York, U.S.A.
1899			Belton, Frank, 103, Lower Seedley-road, Pendleton, Manchester
1879			Bemrose, Joseph, 56, St. Famille-street, Montreal, Canada
1874			‖ Bendix, David, Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1874			Benger, Frederick Baden, F.I.C., The Grange, Knutsford, Cheshire
1881			‖ Benjamin, Marcus, M.A., Ph.D., U.S. National Museum, Washington, D.C., U.S.A.
1886			Bennert, Carl, Ph.D.,
1900			Bennett, A. H., 61, London-road, Bromley, Kent
1899			Bennetts, B. H., Queenstown, Tasmania
1892			Bensusan, Arthur J., 12, O'Connell-street, Sydney, N.S.W.
1896	Trans.		Bentley, W. H., B.Sc., 182, Liverpool-road, Irlam, near Manchester
1890			Bentz, Ernest, 5, Demesne-road, Whalley Range, Manchester
1883			‖ Beringer, Cornelius,
1882			‖ Beringer, John J., Pendarves-road, Camborne, Cornwall
1895			Berkeley, The Earl of, Foscumbe, Boar's Hill, near Abingdon
1890			‖ Berncastle, Richard, 22, Aldridge-road Villas, Bayswater, W.
1893			Berridge, Douglas J. P., M.A. Oxon, The Laboratory, Malvern College
1888			Berridge, Henry Dudley, M.A., Fotheringhay, Oundle, Northamptonshire
1882			‖ Berry, Edward E., Cassa Fanshawe, Bordighera, Italy
1899			Berry, R. A., 59, Southside-street, Plymouth
1891			Berry, Thomas William, Lyndhurst, Stone, Staffordshire
1888			Berry, William, 7, Hampton-park, Redland, Bristol
1883	Trans.	{C. 1898-1900}	Bevan, Edward J., 4, New-court, Lincoln's-inn, W.C.
1886			Bevan, John William, Risedale, St. James-crescent, Swansea
1897			Bhaduri, J. B., M.A., Natoon Bazaar P.O., Krishnaghur, Bengal, India
1865			‖ Bickerdike, W. E., Bryers Croft, Wilpshire, near Blackburn
1875			Biggart, J. W., Chemical Laboratory, 29, Cathcart-street, Greenock

Date of Election.		
1872		Biggs, C. H. W., 140, Salisbury-court, Fleet-street, E.C.
1881		Bingley, John, Northampton
1874		Bird, Henry, Springfield, Bude, North Cornwall
1894		Bird, William Rowland, 12, Gordon-road, New Swindon, Wilts
1899		Birkett, Walter, 23, Cheviot-street, Lincoln.
1875	Trans.	Bischof, Gustav, Prof., 9, Hythe-road, Willesden Junction, N.W.
1879		‖Black, A. H., F.R.G.S., St. John's, Wakefield
1886		Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curacoa, West Indies
1879		Blackett, Cuthbert R., Laboratory, Swanston-street, Old County Court, Melbourne
1899		Blackman, W. L., Mostyn, Mount Nod-road, Streatham, S.W.
1899		Blackshaw, J. F., The Midland Dairy Institute, Kingston Fields, Derby.
1885		Blades, Chas. Mountain, Bay Villa, Chester-road, Northwich, Cheshire
1883		Blair, Frank A.
1890	Proc.	Blake, Robert R. F., Chemical Department, Queen's College, Belfast
1890		Blake, William Henry, Cleadon Tower, near Sunderland
1875		‖Blanshard, Charles Thomas, M.A., F.I.C., 3, Seymour Villas, Totnes
1892		Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1890		Blenkinsopp, W. E. B.
1899		Blofeld, Stuart, B.A., B.Sc., St. Mark's College, Chelsea, S.W.
1896		‖Blood, Maurice, M.A., 3, Stanley-terrace, Clifton-road, Kingston Hill, Kingston-on-Thames
1891		Bloomer, Frederick John, F.I.C., 15, Broderick-road, Upper Tooting, S.W.
1890	Trans.	Blount, Bertram, Laboratory, Broadway, Westminster, S.W.
1888		Bloxam, Arthur G., F.I.C., The Goldsmiths' Institute, New Cross, S.E., and 16, Bolingbroke-road, W. Kensington, W.
1883	Trans.	Bloxam, W. Popplewell, B.Sc., F.I.C., 17, Pembroke-square, Kensington, W.
1887		Blundstone, Edwin Richardson, B.A., Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, T. P., M.A., Tower-place, Shrewsbury
1896		Blyde, J. E. A., 55 Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S., 29, Norfolk-road, N.W.
1892		Blyth, M. Wynter, B.A., B.Sc., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, A., Chemical Works, Stratford, London, E., and Highstanding, Loughton, Essex

Date of Election.		
1899		Boardman, T. H., Blairlodge School, Polmont Station, Stirlingshire, N.B.
1878		Bodmer, Richard, Analytical Laboratory, 16, Southwark-street, London, S.E.
1899		Bogert, M. T., B.A., Columbia University, Amsterdam Avenue, and 116th-street, New York City, U.S.A.
1888		Bohm, William Dunsmore, A.R.S.M., F.I.C.
1899		Bolam, R. A., M.D., 31, Oxford-street, Newcastle-on-Tyne
1869	Trans.	‖Bolas, Thomas, 60, Grove-park-terrace, Chiswick, W.
1899		‖Bond, A. E., Princes Chambers, Corporation-street, Birmingham
1883		Bond, Henry C., M.A., Bromley Park School, Bromley, Kent
1893	Trans.	Bone, William Arthur, D.Sc., Ph.D., Owens College, Manchester
1893		Boone, W. T., B.Sc., 6, Sydenham-villas, Cheltenham
1877		Borland, John, F.L.S., Etruria, Kilmarnock
1884		Borland, W. D., Beacon Lodge, Green St. Green, nr. Dartford, Kent
1881		‖Borns, Henry, Ph.D., 19, Alexandra-road, Wimbledon, S.W.
1895		‖Borradaile, L. A., Selwyn College, Cambridge
1861		‖Bosanquet, R. H. M., F.R.S., c/o Messrs. Castle, Lamb and Storr, Salisbury-square, Fleet-street, E.C.
1894		Bose, Prof. Chuni Lal, 24, Mohendro Bose's-lane, Calcutta
1881		Bostock, G. H., Broadbottom Hall, near Manchester
1881	Trans.	Bothamley, Charles H., F.I.C., Otterwood, Beaconsfield-road, Weston-super-Mare
1887	Trans.	Bott, William, Ph.D., c/o Dr. W. N. Bell, 1, Halefield-road, Bradford
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1871		Bottomley, James, B.A., D.Sc., Homer-terrace, 220, Lower Broughton-road, Manchester
1869		Bottomley, James T., M.A., F.R.S. L. & E., 13, University Gardens, Glasgow
1886		Bottomley, W. Beecroft, Ph.D., 15, Lillyville-road, Fulham, S.W.
1894		Boul, William Good, M.A., LL.D., D.C.L., Tideswell Grammar School, near Buxton
1891		Bovell, John R., Dodd's Botanical and Experimental Station, Barbados
1865		‖Bowdler, A. C., 20, Bank-terrace, Wellington-street, Blackburn
1888		Bower, Frank, 164, Marylebone-road, N.W.
1894		Bowes, Harry, 53, Moss-bank, Higher Crumpsall, Manchester
1899		Bowles, B. H., 53, Dunsmure-road, Stamford Hill, N.
1896		Bowley, J. J., 64, Redcliffe Gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, Mayfield, Knutsford, Cheshire
1862		Bowman, Frederick H., F.R.A.S., F.L.S., F.G.S., Mayfield, Knutsford, Cheshire

Date of Election.		
1896		‖Bowman, H. L., M.A., 13, Sheffield-gardens, Kensington, W.
1894	Trans.	Boyd, D. R., B.Sc., Ph.D., The Hartley College, Southampton
1897		Boylau, A. H., 12, Warwick-road, Ealing, W.
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Woodcote, Chichester
1876		‖Bradley, Nathaniel, Sunnyside, 10, College-road, Whalley Range, Manchester
1888		Bradshaw, Charles, 10, The Nook, Barber-road, Sheffield
1881		Braga, J. F., F.G.S., F.L.S., F.R.G.S., 1, Albert-villas, High-road, Chiswick
1894	Trans.	Brame, J. S. S., Royal Naval College, Greenwich, S.E.
1899		Branscombe, W. H., Halkyn, Flintshire
1890		Branson, Charles F., 1, Old Palace-lane, Richmond, Surrey
1882		Branson, F. W., 14, Commercial-street, and Wynneholme, Far Headingley, Leeds
1899		Bratby, G. S., Oak Field, Hale, Bowdon, Cheshire
1882	Trans.	Brauner, B., Ph.D., Spálená ulice, 1, Prague, Bohemia
1896		Bray, Daniel, Westhill, Wellington-street West, Higher Broughton, Manchester
1898		Brearley, Harry, Totley, near Sheffield
1883		Briant, Lawrence, 24, Holborn-viaduct, E.C.
1897		Brierley, James, 12, Brunswick-square, Southampton
1890	Trans.	Brierley, John Thomas, 96, Bolton-road, Chorley, Lancashire
1898		Brierley, Joseph, B.Sc., Ashton-road, Failsworth, Manchester
1893	Proc.	Briggs, John Frederick, Brooklyn, Wimbledon Park Road, Wandsworth, S.W.
1883		Briggs, T. Lynton, P.O. Box 533, Bergen County, N.J., U.S.A.
1884		‖Briggs, William, 12, Queen Anne-terrace, Cambridge
1890		Brindley, George F.,
1898	Trans.	Brittain, C. E., B.Sc., The Rawlins' School, Quorn, Loughborough
1889		Broadbent, Harry, A.I.C., 187, Hyde Park-road, Leeds
1879		‖Broadbent, John J., 14, Cross-street, Manchester
1883		Brock, John, J.P., Gwern-Tyno, Colwyn Bay, N. Wales
1893		‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth
1884		Brodie, Sir Benjamin V. S., Bart., Brockham Warren, Betchworth
1899		Brooke, Arthur, M.A., Holderness College, Withersea, East Yorks.
1893		Brooke, Edward, 96, Craven Park-road, Harlesden, N.W.
1898		Brooks, C. J., 24, Wood-street, Woolwich
1886	Trans.	‖Brothers, H. E., F.I.C., B.Sc., 117, Summerfield-crescent, Edgbaston, Birmingham
1897		Brothers, W. M., Beechwood House, Prestwich, near Manchester

Date of Election.			
1884		C. 1895- 8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., F.G.S., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, West Heath House, Northfield, Worcestershire
1867	Trans.	C.1872-3 V.P.81-3 90-1 P. 91-3	Brown, A. Crum, Prof., M.D., D.Sc., F.R.S., 8, Belgrave-Crescent, Edinburgh
1870			Brown, David, 93, Abbey-hill, Edinburgh
1891			Brown, Edward, Tannin Extract Works, Station Zelonie Dol, Moscow-Zazan Railway, Russia, and care of Wm. Brown, Heaton-street, Cleckheaton
1873	Trans.	C. 1881-2	‖Brown, Frederic Douglas, Prof., B.Sc., Univ. Col., Auckland, New Zealand
1884			Brown, F. W., 56, Grange Park, Ealing, W.
1892			Brown, George Fitz, The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, G. Noël, Durlstone, Harold-road, Upper Norwood, S.E.
1880			Brown, Henry, Cannon Brewery, Watford, Herts
1871	Trans.	C. 1888-6 V.P.94-7	†Brown, H. T., LL.D., F.R.S., 52, Nevern-square, Kensington, W.
1867	Trans.		‖Brown, James Campbell, D.Sc., 8, Abercromby-square, Liverpool
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1897			Brown, J. H., Gas Works, Ilford, Essex
1893			Brown, Ralph E.,
1892			Brown, Reginald B., Yorkshire College, Leeds
1891			Brown, Robert John, M.Sc., The Technical School, Stockport
1884			Brown, William George, Prof., Ph.D., University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, C. E., B.Sc., Christ's Hospital, E.C.
1893			Browne, Frank, Government Civil Hospital, Hong Kong
1873			Brownen, George, Vectis Villa, Gloucester-place, Boscombe, Bournemouth
1899	Trans.		Browning, K. C., B.A., St. John's College, Cambridge
1890			Brownsword, Frank, Shebbear College, Highampton, North Devon
1894	Trans.		Bruce, James, The Technical College, Huddersfield
1895			Bruckmann, G. T., B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1899			Brünnich, J. C., Agricultural College, Gatton, Queensland
1893	Trans.		‖Brunton, John Dixon, Wire Mill, Musselburgh, near Edinburgh
1877	Trans.		‖Buch, C. von, 20, Hanover-street, W.
1877	Trans.		Buchanan, J. Y., F.R.S., 10, Moray-place, Edinburgh
1876			‖Buckmaster, C. A., 16, Heathfield-road, Mill-hill Park, Acton, W.

† Longstaff Medallist, 1894.

Date of Election.			
1852	Trans.	C. 1855-8, 65-6	‖Buckton, G. B., F.R.S., Weycombe, Haslemere, Surrey
1878			Budden, E. Russell, 28, Church-row, Hampstead, N.W.
1898	Trans.		Bull, B. S., M.A., B.Sc., Ph.D., 21, Lambard-terrace, Ashburnham-road, Greenwich, S.E.
1842			Bullock, Lloyd, 3, Hanover-street, Hanover-square, W.
1890			Bunting, H. H., c/o The Peruvian Corporation, Baquijano, 276B, Lima, Peru
1896			Burbridge, J. K., Bush Lodge, Old Southgate, Middlesex
1891			Burford, Samuel Francis, The Firs, Kirby Muxloe, near Leicester
1898			Burge, C. H., Iddesleigh, Crescent-road, Kingston Hill, S.W.
1894	Proc.		Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.
1884			Burgess, William Thomas, F.I.C., 46, Portland-road, Holland Park, W.
1884			‖Burland, Jeffrey H., 824, Sherbrooke-street, Montreal
1897			Burland, R. O., J.P., Poolstock House, Wigan
1894			Burman, G. W., Laboratory, The Shelton Iron, Steel, and Coke Co., Limited, Stoke-on-Trent, Staffs.
1849	Trans.		Burnard, Charles F., Plymouth Chemical Works, & Chatsworth Lodge, Compton Gifford, Plymouth
1885			Burnett, Joseph Fearon, 8, River View, Ashton, Preston
1893			Burnham, John Charles, 6, Brownhill-gardens, Catford, S.E.
1882	Trans.		Burrell, B. Arthur, 5, Mount Preston, Leeds
1890			Burton, William, Clifton Junction, near Manchester
1882			Bush, Baron William de, Messrs. W. J. Bush and Co., Ash Grove, Hackney, N.E.
1894			Bush, William, Austin Villa, Chepstow-road, Newport, Mon.
1889			Butcher, W. F., c/o Messrs. W. Butcher & Sons, Mfg. Chemists, Blackheath, S.E.
1890			Butcher, William J., The Grammar School, Ashbourne, Derbyshire
1895			Butler, D. Butler, 41, Old Queen-street, Westminster, S.W.
1890			Butler, William Waters, The Cedars, Duchess-road, Edgbaston, Birmingham
1894			Buttemer, Robt. Wm., St. Mary's, Godalming
1875			Butterfield, J. C., 79, Endlesham-road, Balham, S.W.
1892			Butterfield, W. J. Atkinson, M.A., Overdale, Bletchingley, Surrey
1892			Buttfield, Horace Vincent, 13, Wellington-road, Bush Hill Park, Enfield, N.
1888			Byrn, G. A., 97, Pitt-street, Sydney, N.S.W.
1893			‖Cahill, Robert S., Brighton Cottage, Brighton-street, Heckmondwike
1893			Caines, C. M., 12, Carlton-gardens, Sheldon-road, Cricklewood, N.W.

Date of Election.			
1898	Proc.		Caldecott, W. A., B.A., Rand Club, Johannesburg, S.A.R.
1891			‖Calder, William A. S., Brunswick-terrace, Wednesbury, Staffs.
1884			Caley, Edward J., Eaton Old House, Norwich
1896			Caley, John, Monmouth House, Victoria-avenue, Hull
1871			Calvert, J. H., Oakenshaw Print Works, near Accrington
1894			Cameron, Alex., Kronthal im Taunus, Germany
1875			Cameron, J. Macdonald, F.G.S., F.I.C., Castle Hill, Tain, N.B.
1893			Cameron, James, 7, Bolton-road, Port Sunlight, near Birkenhead
1897			Cameron, A. M., School of Mines, Castlemaine, Victoria
1892			Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burmah
1888			Campbell, J. Morrow, B.Sc., F.R.G.S., c/o J. Morrow, Esq., Oakfield House, Anfield, Liverpool
1898			Campion, Alfred, 203, Onslow Drive, Dennistoun, Glasgow
1896			Candy, Hugh, B.A., B.Sc., The College, London Hospital, E.
1884			Cannon, Matthew, Chemical Works, Wickersley-road, Lavender Hill, S.W.
1898			Cannon, M. J., 101, The Chase, Clapham Common, S.W.
1888			Carey, Alfred Edward, M.I.C.E., F.R.G.S., F.G.S., Dominion House, 110, Fenchurch-street, E.C.
1892			Carey, Arthur, B.Sc., Browside, Gateacre, near Liverpool
1889			Carmody, P., Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.		Carpenter, H. C. H., B.A., Ph.D., 109, Banbury-road, Oxford
1875			‖Carpenter, H. S., F.I.C., Beckington House, Weighton-road, Anerley, S.E.
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895	Trans.		Carr, Francis H., 27, Miskin Road, Dartford
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks
1889			Carroll, C. R., Hyderabad, Deccan, India
1882			‖Carruthers, Robert, 90, High-street, Dumfries
1893			Carswell, Thomas Retson, 541, Old Kent-road, S.E.
1864		C. 1878-81, 84-7	‖Carteighe, Michael, 180, New Bond-street, W.
1897			Cartmell, Alfred, Alexander-road, Burton-on-Trent
1867			‖Carulla, F. J. R., 84, Argyle-terrace, Rose Hill, Derby
1895			Case, T. B., B.A., 82, St. James's-street, Dublin
1879			‖Cassal, Major C. E., Town Hall, Kensington, W.
1899			‖Castro, J. P. de, B.A., Ford House, Redruth, Cornwall
1894			Catherall, Ezra, Heathmere, Albany-road, Harborne, Birmingham
1898	Proc.		Caven, R. M., B.Sc., F.I.C., University College, Nottingham
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, A. G., Rugby

Date of Election.			
1894			Chambers, J. F., Arnolds, Nottingham
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			‖Chance, Alexander M.,
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1872			Chandler, William H., Prof.,
1884			Chantrell, P. S., c/o Messrs. Tate & Sons, Ltd., Love-lane Sugar Refinery, Liverpool
1889			‖Chaplin, Edward Mitchell, Ph.D., 60, Westgate, Wakefield
1895			Chapman, A. J., 6, The Hawthorns, Church End, Finchley, N.
1886	Trans.		Chapman, Alfred C., F.I.C., 23, Leadenhall-street, E.C.
1899	Trans.		Chapman, D. L., B.A., Hulme Hall, Plymouth Grove, Manchester
1900	Trans.		Chapman, E. M., 17, Bloomsbury-square, London, W.C.
1868			Chapman, Edward, Hill End, Mottram, Manchester
1884			Chapman, Herbert M., The War and Sporting Smokeless Powder Company, Trimley, Suffolk
1891			Charles, Rhys Pendrill, Plâs Newydd, Neath
1894	Trans.	C. 1900	Chattaway, F. D., D.Sc., Ph.D., M.A., Chemical Laboratory, St. Bartholomew's Hospital, E.C.
1895			Chattaway, William, Apothecaries' Hall, Blackfriars, E.C.
1895			Cheadle, Walter W., B.A., 19, Portman-street, W.
1899			Cheater, T. J., B.Sc., 6, Bontflower-road, Wandsworth Common, S.W.
1890			Cheetham, T. A., Allan Glen's School, 68, North Hanover-street, Glasgow
1887			Chenhall, J. W., M.I.C.E., The Caledonian Mining Corporation, Ltd., Pam, New Caledonia
1878			Cheshire, H. F., Woodside, Shornden, St. Leonards.
1882			‖Chester, Edward D.,
1897			Chikashigé, Masumi, B.Sc., Imperial University, Kyōtō, Japan
1871			Childs, Christopher, M.D., Oxon, 10, Manchester-square, W.
1897			Cholerton, A. F., Beech Leigh, Harboro'-road, Leicester
1891	Trans.		‖Chorley, John C., Lodge-lane, Bewsey, Warrington
1885			Christopher, G., Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William J., 7, West George-street, Glasgow ; and Shawfield Works, Rutherglen, near Glasgow
1856	Trans.	{C. 1876-9, 87-9}	Church, Arthur Herbert, F.R.S., Shelsey, Kew, Surrey
1888	Trans.		Claisen, Ludwig, Prof., Ph.D., Chemisches Institut, Brunswickerstrasse 2, Kiel
1892			Clark, Ernest Victor, 34, St. Aubyns, Hove, Sussex
1876	Trans.		Clark, John, Ph.D., 138, Bath-street, Glasgow

Date of Election.			
1897			Clarkson, Alexander, 2, Waveney-crescent, Ballymena, Ireland.
1852	Trans.		Claudet, Frederic, 6, Coleman-street, E.C.
1886			Clayden, Arthur W., M.A., F.G.S., St. John's, Polsloe-road, Exeter
1882			Clayton, E. Goodwin, F.I.C., 32, Holborn-viaduct, E.C.
1893			Clayton, George, School of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, Bentfield, Hunt's Cross, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1856			Clift, Samuel, 63, Dudley-road, West Bromwich
1878			Cloud, Thomas Charles, A.R.S.M., Walaroo Smelting Works, Walaroo, South Australia
1869	Trans.	C. 1885-9, 1899-	‖Clowes, Frank, Prof., D.Sc., 18, Bedford Court Mansions, Bedford-square, W.C.
1897			Clutterbuck, M. C., B.Sc., Ph.D., 61, Beaconsfield-villas, Brighton
1887			Coates, William Henry, M.A., M.B., L.S.Sc., M.R.C.S., L.R.C.P., L.S.A., Bleak House, Patrington, Yorkshire
1896			Cobb, W. W., M.A., Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A., Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D., 115-119, W. 68th-street, New York, U.S.A.
1879			Cochran, Michael, M.A., Wiesbaden, Kollupitiya, Colombo, Ceylon
1880			‖Cockburn, Arthur Cecil, 156, Willesden Lane, Brondesbury, N.
1895	Trans.		Cockburn, G. B., B.A., B.Sc., Lingdale Lodge, Birkenhead
1892			Cockerill, T., The Technical College, Colombo, Ceylon
1893			Cocking, Allan Thomas, The Grove, Stanford-le-Hope, Essex
1888			Cocking, Lewis Smith, Wharf Mills, Apsley, Huddersfield
1881			‖Coffin, Walter H., 94, Cornwall-gardens, South Kensington, and Junior Athenæum Club, S.W.
1885	Trans.		Cohen, Julius B., Ph.D., Yorkshire College, Leeds
1900			Cole, O. J., B.A., West Monmouthshire School, Pontypool, Mon.
1891	Trans.		Colefax, Arthur, Ph.D., M.A., 4, Brick-court, Temple. E.C.
1883			Coleman, Joseph Bernard, S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Coleman, T. H.,
1883			Collenette, Adolphus, 11, Commercial-arcade, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcestershire
1881			Collett, John Marton, Guys Cliff, Wotton, Gloucester

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1885	Trans.	C. 1889-94, 1900	‖Collie, J. Norman, Ph.D., F.R.S., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc., Kenmore, Shepherd's Hill, Highgate, N.
1899			Collingridge, William, M.A., M.D., Carlton House, St. John's, S.E.
1892			‖Collins, Hugh Brown, B.Sc., 121, West George-street, Glasgow
1890			Collins, Sydney Hoare, Durham College of Science, Newcastle-on-Tyne.
1888			Collins, W. Hepworth, 26, Coupland-street, Oxford-road, Manchester
1887	Trans.		‖Colman, Harold G., Ph.D., 23, Stirling-road, Edgbaston, Birmingham
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1892			‖Comyns, Frank, M.A., The Lindens, Newbury, Berks
1891			Congdon, Prof. Ernest A., The Drexel Institute of Art, Science, and Industry, Chestnut-street, Philadelphia, Penn., U.S.A.
1899			Connah, James, B.Sc., F.I.C., Geralton, Carlton-road, Sidcup
1899			Connell, R. D., 11, Huntingdon-street, Barnsbury, N.
1875			Connor, Charles C., B.A.,
1883			‖Conrad, Edwin C., Manor House, Chalk, Gravesend
1866	Trans.		‖Conroy, Sir John, Bart., F.R.S., Balliol College, Oxford
1875	Trans.		‖Cook, E. H., D.Sc. (Lond.), the Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895			Cook, Herbert W., B.Sc., Dunraven, Park-road, Tunbridge Wells
1890			Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888			Cooke, F. Barker, F.I.C., Messrs. Bostock and Co., South Dock, Garston, near Liverpool
1888			Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889			Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.
1897			‖Cooper, A. J. Bullen, Grimston Lawn, Ealing, W.
1892			Cooper, Arthur James, Harris Institute, Preston
1888			Cooper, Astley, Oatlands Chemical Works, Meanwood-road, Leeds
1898			Cooper, John,
1900			Cooper, W. F., B.A., 6, Hobson-street, Cambridge
1891			Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897			Cooper, W. R., M.A., 87, Upper Tulse-hill, S.W.
1894	Proc.		Coote, A. H., 1, Mycene-road, Blackheath, S.E.
1899			Cope, Frank, 30, Leeds-road, Dewsbury
1890			Coppock, J. B., Technical Schools, Bath
1891	Trans.		Corbett, Charles Henry, The Avenue, Trowbridge, Wilts

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1866			‖Corfield, W. H., M.A., M.D. (Oxon), F.G.S., Professor of Hygiene and Public Health, University College, W.C., and 19, Savile-row, W.
1888			‖Cornish, Vaughan, Branksome Cliff, Bournemouth
1890			Corrie, David, Nobel's Explosives Company, West Quarter Factory, Polmont Station, N.B.
1891			Cory, G. E., M.A., St. Andrew's College, Grahamstown, S.A.
1893	Trans.		Coste, John Henry, 206, Amhurst-road, Hackney, N.E.
1892			‖Couldrey, Henry, H.M.'s Mint, Bombay, India
1885			Cousins, William J., 11 and 12, Southampton-buildings, Chancery-lane, W.C.
1886	Trans.		‖Coutts, Francis J. H., M.D. (Vict.), Cromar, 131, Plymouth-grove, Manchester
1898			Cowburn, A. W., Fernroyd, Bowdon, Cheshire
1882			‖Cowie, Thomas R., Merchant-street, Rangoon, Burmah
1898			Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873			Cownley, Alfred J., 13, Fenchurch-avenue, E.C.
1888			Cowper, Joseph, 50, King-street, Penrith
1886			Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898			Cox, F. Hudson, 14, Bertram-road, Manningham, Bradford
1873			Cox, Samuel Herbert, 13, St. Helen's-place, London, E.C.
1870	Trans.		Crafts, Prof. J. M., 59, Marlborough-street, Boston, Mass., U.S.A.
1892			Craig, Andrew William, College of Pharmacy, Swanston-street, North Melbourne, Victoria
1896			Craig, James, M.A., B.Sc., 4, West Garden-street, Glasgow
1875			‖Crampton, George,
1897			Cranfield, William, 5, Second-avenue, Halifax
1893			Craw, John A., Royal College of Science, South Kensington, S.W.
1882			‖Crawley, H. Howard, Frankfort-house, Stanstead-road, Forest-hill, S.E.
1897			Creasey, C. H., Technical Institute, Wellingborough
1875			Cresswell, Charles Gerard, Ermyngarth, Ashtead
1887			Cribb, Cecil H., B.Sc., 136, Shaftesbury-avenue, W.
1878			Criper, William Risdon, Chemical Works, Konnagar, Calcutta
1895			Crocker, C., St. Peter's-road, Cockett, Swansea
1897	Trans.		Crofts, J. M., B.A., Giggleswick School, Settle
1886	Trans.		‖Crompton, Holland, Glynn-cottage, Chester-road, Northwood, Middlesex
1857	Trans.	C.1866-9 V.P. 76-8, 85-6 P. 87-9	‖Crookes, Sir William, F.R.S., 7, Kensington Park-gardens, W., and Athenæum Club, Pall Mall, S.W.
1879	Trans.	C.1890-1 93-5	Cross, Charles Frederick, 4, New-court, Lincoln's-inn, W.C.

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1896		Cross, G. H., B.Sc.
1890	Trans.	‖Crossley, Arthur W., D.Sc. (Vict.), Ph.D., Chemical Laboratory, St. Thomas's Hospital, S.E.
1896		Crossman, C. M., B.Sc., South-lodge, Edgware, Middlesex
1895		Crossman, Tom, 40, Coldhurst-street, Oldham
1899		Crouch, W. S., Hersham, Walton-on-Thames
1880	Trans.	Crow, John Kent, D.Sc., Tressillian, Ulandi-road, Blackheath, S.E.
1887		‖Crowther, H. Woodward, The Beeches, West Bromwich
1897		Crowther, James, B.Sc.
1895		Croysdale, John, Whitley Bridge, R.S.O., Yorkshire
1884		Crumbie, William D., 146, Washington-street, East Orange, New Jersey, U.S.A.
1887	Trans.	Cundall, J. Tudor, B.Sc., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1899		Cunnington, A. V., c/o Mrs. Loftus Lucas, 7, Fordwych-road, West Hampstead, N.W.
1875		Curphey, W. S., Borva, Lenzie, N.B.
1881		‖Custance, John D., Prof., Newport-road, Cowes, Isle of Wight
1895		Cuthbertson, Gurney, The Thames White Lead Co., Morden-wharf, East Greenwich, S.E.
1894		Dains, Herbert H., F.I.C., 3, Cantonment, Vizianagram, India
1882		Dampier, Henry L., The Vicarage, Lenham, Kent
1897		Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal
1887		Daniell, L. C., Royal Standard Brewery, Tamworth, N.S.W.
1850		‖Danson, Joseph,
1899		Danziger, H. M., Clent House, Woodland-road, Northfield, Birmingham
1892		Darbishire, Francis V., B.A., Ph.D., Rossplatz 12, I., Leipzig
1852		Darby, Stephen, Cookham Dean, Berks
1899		Darling, C. R., 12, Nithdale-road, Plumstead, S.E.
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	Darling, William Howarth, 126, Oxford-street, Manchester
1875		‖Davey, G. W., Bleak House, Barking Creek, Essex
1893		Davey, George, c/o The Waitekauri Gold Mines, Ltd., Waitekauri, Auckland, N.Z.
1897		Davidge, H. N., 9, Eastmearne-road, West Dulwich, S.E.
1876		‖Davidson, Joseph, Green Bank, Holywell Green, Halifax
1899		Davidson, W. B., M.A., B.Sc., Ph.D., 29, Bedford-street, Liverpool
1866	Trans.	‖Davies, Arthur E., Ph.D., Tweedbank, West Savile-road, Edinburgh
1898		Davies, C. W. T., Long Whatton, Loughborough, Leicestershire

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1858	Trans.		Davies, Edward, The Laboratory, 28, Chapel-street, Liverpool
1894			Davies, S. H., Rowntree's Cocoa Works, York
1896			Davies, L. J., Bute Chambers, Bute-road, Cardiff
1857			‖Davis, J. Frederick, F.G.S., Archbrook, Budleigh-Salterton, Devon
1872	Trans.		‖Davis, Richard Hayton, 26, Regent-parade, Harrogate
1876			Davis, T. Sebastian, 199, South Lambeth-road, S.W.
1897	Trans.		Davis, W. A., Central Technical College, South Kensington, S.W.
1876			‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1895			Daw, F. W., Eureka-place, Ebbw Vale, Monmouthshire
1900			Dawson, H. M., B.Sc., Ph.D., The Yorkshire College, and North-terrace, Bramley, Leeds
1899			Dawson, H. Royal, 3, Kenilworth-road, Ealing, W.
1890			Day, Charles Edwin, 145, Abbey-road, Barrow-in-Furness
1881	Trans.		‖Day, T. Cuthbert, 36, Hillside-crescent, Edinburgh
1886			Deane, Leopold M., Davington-house, Faversham
1859	Trans.	V.P. 1871-3	Debus, Heinrich, Prof., Ph.D., F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1885	Trans.		Dechan, Martin, Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, 9, King's-parade, Cambridge
1869	Trans.		Deering, W. H., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1881			Demarçay, Eugene Anatole, 80, Bd. Malesherbes, Paris
1892			Denison, Joseph R., 1, Park-view-terrace, Manningham, Bradford
1890			Dennant, John, F.G.S., Russell Street, Camberwell, Victoria
1897			Deverell, L. C., 30/31, St. Swithin's Lane, E.C.
1870	Trans.	C. 1874-6 V.P. 80-2 86-7, 96-7 P. 97-9	‖Dewar, James, Prof., M.A., LL.D., F.R.S., Royal Institution, Albemarle-street, W.
1900			Dewhirst, J. A , 125, Mount View-road, Stroud Green, N.
1886			‖Dey, Preo Lall, 4, Beadon-street, Calcutta
1897			Diamond, William, Pyebridge, Alfreton, Derbyshire
1880			Dibdin, W. J., F.I.C., Mayfield, Grange-road, Sutton, Surrey
1872			Dickenson, Arthur John, F.I.C., 4, Shardeloes-road, New Cross, S.E.
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1887			Dickson, T. Arthur, Estate Office, Overstone Park, Northampton
1860	Trans.	C. 1873-4 V.P. 1900	‖Divers, Edward, Prof., M.D., F.R.S., 34, St. Mary Abbot's-terrace, Kensington, W.
1897			Dixon, A. J., Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900	Dixon, Augustus Edward, Prof., M.D., Queen's College, Cork
1896	Trans.		Dixon, Frank, B.Sc., The Foundation School, Whitechapel-road, E.
1894	Proc.		‖Dixon, George, M.A., Trinity College, Cambridge and St. Bees, R.S.O., Cumberland

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1876	Trans.	1892-6 C.	‖Dixon, Harold B., Prof., F.R.S., Owens College, Manchester
1893			Dixon, Harry W., Clarence Iron and Steel Works, Leeds
1895			Dixon, W., 102, Spring-street, Bury
1862			Dixon, W. A., 97, Pitt-street, Sydney, N.S.W.
1890			Dixon, William, 4, Park-place East, Sunderland
1882	Trans.		Dobbie, James Johnstone, Prof., M.A., D.Sc., University College, Bangor, N. Wales
1887	Trans.		Dobbin, Leonard, Ph.D., Chemical Laboratory, New University-buildings, Edinburgh
1898			Dodd, F. R., Victoria-terrace, Southport-road, Ormskirk
1875	Trans.		Dodd, T. H., Chemical Department, Royal Arsenal, Woolwich, S.E.
1888			‖Dodd, William Henry, 8, Kempson-road, Walham-green, S.W.
1886			Dodd, W. Ralph, Oakdene, Bush-hill Park, Enfield, N.
1892			Dodds, George Price, 40, Greenbank-road, Darlington
1897			Dodgson, J. W., B.Sc., Eversley, Llewellyn-street, Aberdare, S. Wales
1894	Proc.		Doherty, W. M., Government Laboratory, Sydney, N.S.W.
1898			Don, J. R., M.A., D.Sc., Waitaki High School, Oamaru, N.Z.
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1897	Trans.		Dootson, F. W., M.A., 6, Park Side, Cambridge
1886	Trans.		Doran, Robert Elliott, Chemical Dept. Queen's College, Cork
1886			Dormer, Richard, Garston
1900			Dougall, J. D., Senhouse-street, Maryport, Cumberland
1888			Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1884			Down, Frederick J., Glengariff, Milton-road, Harpenden, Herts.
1887			Downes, Arthur H., M.D., Local Government Board, Whitehall, S.W.
1898	Trans.		Dowzard, Edwin, 64, Cambridge-road, Seaforth, Liverpool
1896			Doyle, Frederick, 64, Palmerston-terrace, Middlesbrough
1899			Drake, F. A., The Grammar School, Hull
1884			Draper, Henry Carter, 25, Earlsfort-terrace, Dublin
1891			Dreaper, W. Porter, Clifton Villa, Coggeshall-road, Braintree, Essex
1893			Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1895			Druce, Edric, Agricultural College, Holmes Chapel, Cheshire
1897			Duckham, Alexander, 40, Croom's-hill, Greenwich-park, S.E.
1900			Dudderidge, F. R., 45, Sydney-grove, Newcastle-on-Tyne
1898			Dudley, C. B., Ph.D., Drawer 334, Attoona, Penn., U.S.A.
1890			‖Dudley, William L., Prof. Vanderbilt Univ., Nashville, Tennessee, U.S.A.
1893	Trans.		‖Dufton, Samuel Felix, M.A., D.Sc., Dingley, Upper Bridge-road, Red Hill, Surrey

Date of Election.			
1892			Duffield, Walter William, 5, Ashington-road, Parson's-green, S.W.
1897			Dufty, Lawrence, 23, Broomhall-place, Sheffield
1884			Duggan, T. R., Sunny-bank, Vanburgh-hill, Westcombe-park, Blackheath, S.E.
1889			Duisberg, Dr. Carl, Elberfeld, Germany
1889			‖Dukes, Thomas William, P. T. Peterson and Co., P.O. Box 210, Johannesberg, S.A.R.
1881			Duncan, Arthur W., 42, Trevelyan-street, Eccles, Manchester
1894	Proc.		‖Duncan, C. C., The Shire Hall, Worcester
1863			Duncan, James, 9, Mincing-Lane, E.C.
1894			Duncan, Dr. John,
1891			Duncan, William, The Laboratory, 65, Bath-row, Edgbaston, Birmingham
1896			Duncan, William, Royal Dispensary, 21, W. Richmond-street, Edinburgh
1894	Proc.		‖Dunn, Frederic, 193, Collins-street, Melbourne
1888			Dunn, John, B.Sc., Morgan Academy, Dundee
1882			Dunn, J. T., D.Sc., Northern Polytechnic Inst., Holloway, N.
1893			Dunnington, Francis P., University of Virginia, Charlottesville, U.S.A.
1899			Dunscombe, F. C., 54, Woodstock-road, Bristol
1885			Dunstan, M. J. R., M.A., F.R.S.E., Newcastle Circus, The Park, Nottingham
1879	Trans.	C. 1888-91 S. 93-	‖Dunstan, Wyndham R.. Prof., M.A., F.R.S., Scientific Department, Imperial Institute, S.W.
1860	Trans.	C. 1871-4	Dupré, August, Ph.D., F.R.S., 2, Edinburgh Mansions, Howick Place, S.W.
1896			Durant, H. T., Minas Prietas Reduction Syndicate, Torres, Sonora, Mexico, *viâ* New York and Nogales
1871			‖Durham, Henry, 32, Fitzroy-street, Fitzroy-square, W.
1883	Proc.		Durrant, Reginald G., M.A., The College, Marlborough, Wilts.
1892			Duxbury, Thomas, 17, Grosvenor-chas., Deansgate, Manchester
1875	Trans.	C. 1893-7	‖Dyer, Bernard, D.Sc. (Lond.), 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, 78, Duke-street, Chelmsford
1885	Trans.		Dyson, Gibson, Ph.D., Hatfield Court, Leominster
1883	Trans.		‖Dyson, Septimus, 2, Exchange-place, Middlesbrough
1876			‖Earp, Francis S., Ph.D., F.I.C., P.O., Coolgardie, W.A.
1889	Trans.		Easterfield, Thomas Hill, Prof., M.A., Ph.D., The Victoria College, Wellington, New Zealand.
1891			Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
1881			Eastick, John J., Millaquin Refinery, Bundaberg, Queensland

Date of Election		
1878	Trans.	‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1881		Edgell, R. Arnold, Rev., M.A., The College House, Leamington
1876		Edmunds, James, M.D., 26, Manchester-square, W.
1893		Edwards, Thomas, Brewery House, Rhymney, viâ Cardiff
1884		Edwards, Vincent, Lawes' Chemical Manure Co., Barking Creek, Essex
1897		Edwards, W. B.,
1892		Edwards, Walter N., 4, Herne Hill-road, Camberwell, S.E.
1898		‖Edwards, W. T. A., Experiment Station, Reduit, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc., Ph.D., A.M.C. Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany
1884		Ehrmann, Leon, c/o Messrs. Packard & Co., Ltd., Ipswich
1899		Eichenauer, W. F., 58a, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, 143, New Bond-street, W.
1883		‖Ekins, Arthur E., Worley House, St. Albans
1887		Elborne, William, M.A. (Cantab.), Thorpe-road, Peterborough
1891		Elford, Percy, St. John's College, Oxford
1878		Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, W. J., M.A., The Grammar School, Leeds
1893		Ellis, C. Sordes, A.I.C., Smokeless Powder and Ammunition Co., Ltd., Barwick, near Ware, Herts.
1890		Ellis, Thomas Flower, c/o W. T. Flower Ellis, Esq., Thatched House Club, St. James's-street, S.W.
1878		Ellis, W. H., School of Practical Science, Toronto, Ontario, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1888		Ellwood, Thomas Ashcroft, 111, Stroud Green-road, N.
1893		Elmore, Alexander Stanley, Roundhay, Leeds
1886	Trans.	Elworthy, Herbert Samuel, 239, Dashwood House, New Broad-street, E.C.
1885		Embrey, George, County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton,
1892		Entwistle, Herbert, 1, Albert-place, Dickenson-road, Longsight, Manchester
1899		Epps, J. W., 95, Upper Tulse Hill, S.W.
1885		Epps, James, junr., Norfolk House, Beulah Hill, Upper Norwood, S.E.
1889		Erskine, J. Kerr, New Kleinfontein Co. (per Private bag), Johannesberg, S.A.R.
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862		‖Esson, William, Prof., F.R.S., Merton College, Oxford
1865		‖Estcourt, Charles, 20, Albert-square, Manchester

Date of Election.			
1899			Estcourt, H. E., 10, Anderson's Quay, Cork
1888			‖Estcourt, Philip Anderson, Seymour House, Seymour-grove, Old Trafford, Manchester
1894			Eumorfopoulos, Nicholas, B.Sc., 33, Gloucester-square, Hyde Park, W.
1895			Eutroppe, A. T., U.S. General Hospital, San Juan, Porto Rico
1891			Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope
1876			Evans, Gwilym, 7, Stepney-street, Llanelly, South Wales
1893	Trans.		‖Evans, Robert Cecil Turle, 9, Heathcote-street, Grays Inn-road, W.C.
1892			Evans, Sir John, K.C.B., D.C.L., LL.D., F.R.S., Nash Mills, Hemel Hempstead
1888			‖Everard, Arthur George, Normanhurst, 115, Broomwood-road, Wandsworth Common, S.W.
1894			Evershed, Frank, Kenley, Surrey
1896	Trans.		Ewan, Thomas, M.Sc., Ph.D., The Aluminium Co., Ltd., Oldbury, near Birmingham
1896	Trans.		Ewen, E. D., c/o The West Indian Tobacco Co., Port of Spain, Trinidad
1888			Faber, Harold N., 7 and 8, Idol-lane, E.C.
1865	Trans.		‖Fairley, Thomas, F.R.S.E., 17, East-parade, Leeds
1895			Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899			Fairweather, E. B., King's College Hospital, Lincoln's Inn Fields, W.C.
1888			Farlie, John B., 54, Wellington-road, Old Charlton, Kent, S.E.
1895			Farr, E. H., Uckfield, Sussex
1870			‖Farries, Thomas, 16, Coleman-street, E.C.
1880			‖Farrington, Thomas, M.A., 5, Summerhill-terrace, Wellington, Cork
1895			Fauvel, C. J.,
1894			Fawcett, Joseph Addey, 54, Broxholme-road, Doncaster
1895			Fawns, Sidney,
1887			Fawsitt, Charles A., 9, Foremount-terrace, Dowanhill, Glasgow
1888			Fell, John Campbell, 45, Gifford-street, N.
1897			Fenby, A. V. C., B.Sc., Hinton House, Huddersfield-road, Birstall, Leeds
1878	Trans.	C. 1898-	‖Fenton, H. J. H., M.A., F.R.S., Christ College, Cambridge, and 7, Mortimer-road, Cambridge
1872		C. 1889-93	‖Ferguson, John, Prof., M.A., University of Glasgow
1898			Ferguson, J. E., 26, Connaught-road, Stroud Green, N.
1899			Fermor, H. F. F. B., 15, Ansdell-road, Peckham, S.E.
1864			‖Ferreira, A. A., M.P.S.

Date of Election.			
1889			Ferrier, David, 1, Edin-terrace, Perth
1882			Ferrier, James, Columbus, Georgia, U.S.A.
1897			Field, C. H.,
1895			Fielding, P. J. D., 8, St. Joseph's-place, Cork
1900	Trans.		Findlay, Alexander, M.A., B.Sc., Emilien strasse 10 I, Leipzig
1890			Findlay, George H., Burmantofts Brewery, Leeds
1896			Fisher, E. H., The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Frederick William, M.A., 64, Pont-street, S.W.
1894			FitzGerald, Rev., Henry Purefoy, M.A., F.L.S., Barracane, Wellington College, Berks
1896			Fleet, J. T., 24, Sheep-street, Rugby
1899			‖Fleischmann, F. N. A., 6, Collingham-gardens, South Kensington, S.W.
1898			‖Fleming, J. A., Britannia Pottery, 136, Glebe-street, Glasgow
1874			Fletcher, Frederick W., North London Chemical Works, Holloway, N., and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A., F.R.S., Natural History Department, British Museum, Cromwell-road, S.W.
1872	Trans.		‖Fletcher, Thomas William, Grappenhall, Warrington
1894			‖Flintoff, Robert J., Haxby, Crumpsall-lane, Crumpsall, Manchester
1892			Floris, Robert Brooke, Church-house, West Hanningfield, near Chelmsford
1894			Fogg, C. A., 39, Park-road, Bolton
1859			Fogg, Thomas, 6, Clarendon-gardens, Maida-vale, W.
1889			Foggie, John, University College, Dundee
1885			Follows, Harold, Victoria Villas, Humphrey-lane, Urmston, near Manchester
1894			‖Forbes, D. G., The Post Office, Kalgoorlie, West Australia
1874			Forbes, James, jun., 70, Gracechurch-street, E.C.
1889			Ford, John S., care of Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton
1893			Forrester, Alexander M., Laboratory, Port Dundas Chemical Works, 20, Canal Bank, Glasgow
1892	Trans.		‖Forster, Martin Onslow, Ph.D., Royal College of Science, South Kensington, S.W.
1888			Forsyth, W. Cay, St. Andrew, 46, Queen's-road, Leytonstone, N.E.
1856	Trans.	C. 1865-8, 72-4, 85-6 V.P. 88-92	‖Foster, Prof. G. Carey, F.R.S., Ladywalk, Rickmansworth, Herts
1895			Foster, H. Irving, 2, Beech-grove, Newland, Beverley-road, Hull
1865		C. 1873-5	Foster, Sir Michael, M.A., M.D., D.C.L., LL.D., M.P., F.R.S., Trinity College, Cambridge

Date of Election.			
1872			Foster, Reginald Le Neve, Harrytown Hall, Bredbury, near Stockport
1898			Foulerton, A. G. S., F.R.C.S , Dunsdale, Mulgrave-road, Sutton, Surrey
1891	Trans.		‖Fowler, Gilbert J., M.Sc., 110, Flixton-road, Urmston, Manchester
1882			‖Fowler, William, M.Sc., 1, Grace-terrace, Sunderland
1895			Fox, A. Stanley, 23, South-road, Faversham
1884			‖Foye, Martin Hugh, M.B., C.M.,
1879			Francis, Edward, Ivy Bank, Park Valley, Nottingham
1873			‖Francis, G. Bult, 38, Southwark-street, S.E.
1842	Trans.	C. 1860-2	Francis, William, Ph.D., F.L.S., Manor-house, Richmond, Surrey, and Red Lion-court, Fleet-street, E.C.
1881			Frankland, Henry, Streonshalk, The Crescent, Linthorpe, Middlesbro'
1880	Trans.	C. 1887-8	‖Frankland, Percy Faraday, Prof., Ph.D., F.R.S., Mason College, Birmingham
1867			‖Fraser, Angus, M.D., 232, Union-street, Aberdeen
1892			‖Fraser, James C., Mercantile-chas., Victoria-square, Adelaide, S.A.
1899			Fraser, W. G., Golspie, St. Albans
1885			Freear, Harry M., Hedgefield, Harpenden, Herts
1887			Freeman, Frederick W., 7, Park Hall-place, East Finchley, N.E.
1889			Freestone, Joseph T., 1, Alexander-terrace, Rock Ferry, Cheshire
1892	Proc.		French, William, Highfield, 135, Walmersley-road, Bury, Lancs.
1889	Trans.		Frew, William, Well Park Brewery, Glasgow
1871	Trans.	C. 1884-8, 92-6	‖Friswell, R. J., 115, Darenth-road, Stamford Hill, N.
1884			Frost, Joe, Moldgreen, Huddersfield
1890			‖Frost, Robert, B.Sc., 53, Victoria-road, Kensington, W.
1899			Fry, G. C., B.Sc., The Grammar School, Newbury, Berks.
1899	Trans.		Frye, C. C., Burwood, Woodville-road, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A., Ph.D., 13, Eaton-crescent, Clifton, Bristol
1895			Fuerst, A. F., Ph.D., 38, Circus-road, N.W.
1891			Fulcher, Lionel William, B.Sc., Victoria and Albert Museum, S.W., and 56, Buckleigh-road, Streatham Common, S.W.
1896			Fuller, C. J. P., Mona House, Horwich, Lancs.
1893			Fuller, Frederick George, 85, Shooter's Hill-road, Blackheath, S.E.
1886			Fuller, John, Rookwood, Montpelier-road, Ealing, W.
1883			Fulton, H. B., 353, Mansion House Chambers, 11, Queen Victoria-street, E.C.
1894			Gabb, George Hugh, 43, Charlotte-street, Fitzroy-square, W.
1899			Gabriel, E. V., Bengal United Service Club, Calcutta.
1892			Gailleton, Alfred T., Tulloch House, Perth, N.B.

Date of Election.		
1866		Gale, James, M.A., Ph.D., F.G.S., 124, Adelaide-road, South Hampstead, N.W.
1851		‖Gamble, Sir David, Bart., C.B., Windlehurst, St. Helens, Lancashire
1876		Gamble, J. C., Haresfinch, St. Helens, Lancashire
1883	Proc.	‖Garbutt, Llewellyn, M.A., 10, College-street, Winchester
1888		Gardiner, James H., 59, Wroughton-road, Balham, S.W.
1895		Gardner, H. Edward, B.Sc., The College, Epsom, Surrey
1896		Gardner, James, 413, Park-road, Oldham
1893	Trans.	Gardner, J. Addyman, M.A., Chemical Department, St. George's Hospital, S.W.
1888		Gardner, Walter M., Technical College, and Willow Cottage, Cross-lane, Gt. Horton, Bradford
1893	Trans.	Garnett, Henry, 12, Gt. Western-street, Moss Side, Manchester
1889		Garrett, Frederic Chas., M.Sc., Durham College of Science, Newcastle
1880		Garrod, A. E., M.D., 9 Chandos Street, Cavendish-square, W.
1898		Garside, A. L. H., B.Sc., Chantry House, Deansgate, Great Grimsby.
1884		Gaskell, Joseph, 71, Haworth-buildings, Cross-street, Manchester
1847		Gatty, F. A., Bannister Hall Works, near Preston, Lancashire
1875		Gee, T. Ernest, F.R.C.P., 67, Westbourne-park-road, W.
1887		Geisler, Joseph F., Ph.C., Mercantile Exchange Buildings, Hudson and Harrison-streets, New York
1900		Geldard, Julius, 120, Park Field-terrace, Otley Road, Bradford
1885		Gemmell, George Harrison, 4, Lindsay-place, Edinburgh
1879		Gent, William Thomas, Misterton, Gainsborough
1896		George, George, Kingswood House, Kingswood, near Bristol
1889		‖Gerland, Conrad, M.Sc., Ph.D., Meadow Bank, Accrington
1891		German, George, jun., Huntingdon House, Ashby-de-la-Zouch
1895		‖Gerrans, H. Tresawna, M.A., 20, St. John Street, Oxford
1875		Gerrard, A. W., 35, Queen's-road, Wimbledon, S.W.
1899		Getman, F. H., 196, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Surgeon-Major, Chemical Examiner, Medical College, Madras, East India
1894		Ghasvala, B. E.,
1890		‖Gibbes, Cuthbert C., M.D., M.C., L.R.C.P., D.P.H.,
1897		Gibbons, J. L., The Higher Grade School, Blyth, Northumberland
1885		Gibson, Adam, c/o Messrs. Pinkerton, Gibson & Co., Thistle-street-lane East, Edinburgh
1892	Trans.	Gibson, John, Ph.D., F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1888		Gibson, W. Humphrey, 122, King's-road, Brighton
1898		Gidden, W. T., The Hawthorns, Moat-road, Warley, near Birmingham

Date of Election.			
1895			Gilbard, J. F. H., 8, Glaskin-villas, Lea Bridge-road, N.E.
1841	Trans.	C. 1856-9 V.P. 1868-72, 75-7, 79-81 P. 1882-3	Gilbert, Sir Joseph Henry, LL.D., D.Sc., Ph.D., F.R.S., F.L.S., Harpenden, St. Albans
1897	Proc.		Gilbody, A. W., M.Sc., Ph.D., Owens College, Manchester
1898			Gilderdale, Frederick, 3, Havelock-street, Newcastle-on-Tyne
1883			‖Gill, E. Clarendon, Ivy Dene, Christchurch, Hants
1881			Gill, E. I. G., 5, Brondesbury-villas, Kilburn, N.W.
1888			Gill, John, Gwealhellis, Helston, Cornwall
1898	Proc.		Gilles, W. S., Bradford-street, Bocking, Braintree, Essex
1865			‖Gillman, A. W.,
1885			Girdwood, Gilbert P., M.D., 111, University-street, Montreal
1897			Girtin, Thomas, B.A., 125A, Highbury New Park, N.
1848	Trans.	C. 1852-5, 61-2 V.P. 1867-9, 74-6 P. 1877-9	Gladstone, John Hall, Ph.D., F.R.S., 17, Pembridge-square, Hyde Park, W.
1898			Glaister, John, Prof., M.D., 4, Grafton-place, Grafton-square Glasgow
1872			‖Glover, George Thomas, Corbys, Hoylake, Cheshire
1895			Goddard, Wm., 11, Granville-road, Middlesborough
1895			Goldfinch, George, Hendon, N.W.
1899			Golding, John, 1, Balmoral-road, Nottingham.
1878			‖Goldschmidt, S. A., Ph.D., care of Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, New York, U.S.A.
1889			Goldsmith, Byron B., 19, East 74th-street, New York City U.S.A.
1898			Goldsmith, J. N., B.Sc., Ph.D., British Xylonite Co., Manningtree, Essex.
1896			Goldstand, L. F.,
1899			Goltz, H. F. C., 7, Craster-road, Upper Tulse Hill, S.W.
1897			Gomess, A. F. Bilderbeck, M.R.C.S., 33, Drayton-gardens, South Kensington, S.W.
1892			Goodall, Walter, Alma House, Pudsey, near Leeds
1890			Goodwin, Thomas S., Prof. Veterinary College, Buccleuch-street, Glasgow
1896			Goodwin, William, Queen's College, Galway, and Thorncliffe, Macclesfield
1890			Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1887	Proc.		Gordon, Hugh, M.A. Oxon, Eastmount, Darlington.
1875			Gordon, J. G., Queen Anne's Mansions, Westminster, S.W.
1890			Gossling, Frank, B.Sc., H.M. Patent Office, Staple Inn, W.C.
1883			Gothard, Frederic, Bearwood House, Burton-on-Trent
1889	Trans.		‖Gott, B. S., M.A., The Guildhall, Westminster, S.W.
1897			Gough, H. W., B.A., 58, Billing-road, Northampton

Date of Election.			
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, 18, Mercers-road, Holloway, N.
1887			Gover, Herbert J., 29, Piccadilly, Hanley, Staffordshire
1889			Gow, Robert J., Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, 18, West View-road, Barrow-in-Furness
1871	Trans.	C. 1898.	‖Gowland, William, 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George A., Hawkins-road, Medindie, Adelaide, South Australia
1884			Grace, W. F., 54, York-road, Hove, Brighton, and the Lake View and Boulder Junction Gold Mines, Limited, Kalgoorlie, W. Australia
1894			Grafton, Walter, 102, Byron-avenue East, East Ham, Essex
1880	Trans.		‖Graham, C. Colborne, Highmoor, Benrhydding-road, Ilkley, Yorks
1862		C. 1880-1	*‖Graham, Charles, D.Sc., The Reculvers, Hastings.
1895	Trans.		Graham, Edward, B.Sc., The Grange, Woodlands-road, Redhill
1890			Grant, James, 9, Arthur-street, Prestwich, near Manchester
1895	Trans.		Grant, P. Hope, 94, Copleston-road, Denmark-hill, S.E.
1887			Gravill, Edward D., F.R.M.S., 42, Walmsley-street, Hull
1882			Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900			Gray, R. W., 7, Orme-court, Bayswater, S.W.
1892	Trans.		Gray, Thomas, Andersonian-buildings, 204, George-street, Glasgow
1890			Green, Alfred H., Oaklands, Lowton St Mary's, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, 13, King's-drive, Heaton Moor, near Stockport
1893			Green, Arthur Henry, 207, Lloyd-street, Greenheys, Manchester
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, F.I.C., A.R.S.M., 1, Queen's-road, Urmston, Manchester
1878			Green, Lawrence, Lower Tovil, Maidstone
1874	Trans.		‖Greenaway, Alfred John, F.I.C., 39, Frognal, Hampstead, N.W.
1885			Greene, William H., M.D., 204, North 36th-street, Philadelphia, U.S.A.
1885			Greenway, Thomas J., 2nd Avenue, St. Peter's, South Australia
1873			Greenwood, William Henry, Birmingham Metal and Munitions Co., Ltd., Adderley Park Works, Birmingham
1894	Proc.		Greeves, A., 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D., B.Sc., Colonial Secretary's Office, Cape Town
1885			Gregory, G. M., Ghazipur, N.W.P., India
1883			‖Grenfell, Claud, M.A., c/o Miss Boole, 16 Ladbroke-road, W.
1874			Greville, Henry Leicester, Diersheim, Churchfields, Woodford

Date of Election.			
1896			Grice, W. T., 9, Dalhousie-square, Calcutta
1893			Grieve, William Hatten, 226, Friern-road, East Dulwich, S.E.
1888			Griffith, D. Agnew,
1859			Griffith, George, M.A., College-road, Harrow
1881	Trans.		Griffiths, Arthur Bower, Ph.D., F.R.S.E., 12, Knowle-road, Brixton, S.E.
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 10, Eden Place, Stanwix, Carlisle
1874	Trans.		‖Grimshaw, Harry, Sunnyside, North-road, Clayton, Manchester
1880			Grimwood, Robert, London County Council, Chemical and Gas Department, 40, Craven-street, W.C.
1893			Grimwood, Robert George, 17 Dagmar-road, Stroud Green, N.
1889			Gripper, Harold, 2, Heald-place, Rusholme, Manchester
1892			Gronow, William Thomas,
1895			Grossman, E. H., 12, Alfred-place West, South Kensington, S.W.
1871	Trans.	C. 1877-8 V.P. 1899.	‖Groves, Charles Edward, F.R.S., Kennington-green, S.E., and Guy's Hospital, S.E.
1897			Grundey, F. R., B.Sc., 20, Derby-road, Douglas, Isle of Man
1897			Guest, E. Graham, M.A., B.Sc., 5, Churchill, Edinburgh
1895			Gunn, A., c/o Messrs. Lorimer and Co., Britannia-row, Islington, N.
1898			Guthrie, Alexander, B.Sc., The Cottage, Bocking, Braintree, Essex
1888	Trans.		Guthrie, Frederick Bickell, Chemical Laboratory, The University, Sydney, New South Wales
1897			Guttmann, Oscar, 12, Mark-lane, E.C.
1875			Guyer, James Brett, Wrentham, Higher Erith-road, Torquay
1897			Guyer, R. Glode, c/o Messrs. Duncan, Flockhart, and Co., 104, South Bank, Canongate, Edinburgh
1874			Habirshaw, W. M., Glenwood Works, Yonkers, New York, U.S.A.
1878			‖Hadkinson, John,
1894			Hadley, Arthur, c/o Messrs. Toohey, Ltd., Standard Brewery, Sydney, N.S.W.
1898			Hadley, E. B., The Green, Calne, Wilts
1893			‖Hadley, Henry Edwin, Science School, Kidderminster
1886	Trans.		Haga, Tamemasa, D.Sc., College of Science, University of Tokio, Japan
1899			Haigh, Percy, c/o Messrs. J. and J. Lonsdale and Co., Ltd., Longford, Ireland
1881			Hailes, Alfred James de, 15, Red Lion-square, W.C.

Date of Election.			
1892			Haines, Walter S., Prof., c/o Rush Med. College, Chicago, U.S.A.
1876	Trans.		Hake, H. Wilson, Ph.D., Westminster Hospital Medical School, Caxton-street, S.W.
1893			Hale, Henry Ormsby, Oundle School, Northamptonshire
1891			Hall, A. D., S.E. Agricultural College, Wye, Kent
1889			Hall, Allan T., Ivy Cottage, Willerby, near Hull
1891			Hall, Archibald, 34, Bishopsgate-street, E.C.
1889	Trans.		Hall, John A., Victoria Chemical Works, Victoria, B.C.
1876			Hall, Samuel, East London Soap Works, Bow
1899			‖Hall, S. G., 19, Aberdeen-park, Highbury, N.
1893			Haller, Albin, Prof., 1, Rue de Goff, Paris
1886			Halliburton, William Dobinson, Prof., M.D. Lond., B.Sc., F.R.S., Church-cottage, 17, Marylebone-road, W.
1897			Halliwell, Edward, c/o West Riding Rivers Board, Wakefield
1859			‖Hambly, C. H. Burbridge, "Fairley," Weston, Bath
1890	Trans.		Hambly, Frederick J., c/o The Electric Reduction Co., Buckingham, Que., Canada
1888	Trans.		Hamilton, James C., Arncliffe, Arnside, viâ Carnforth
1898			Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks
1897			Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1894			Hamilton, Robert, Leeds Steel Works, Leeds
1875	Trans.		Hamlet W. M., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1877			Hampton, William, 38, Lichfield-street, Hanley
1857			Hanbury, Cornelius, Plough-court, Lombard-street, E.C., and Dynevor House, Richmond, Surrey
1893			Hancock, Ernest Albert, Dalsing Sarai, Tirhoot, Bengal, India
1895	Trans.		Hanes, E. S., 108, Alexandra-road, N.W.
1896			Hanger, R. H., Riverslea, Stoneferry, Hull
1872	Trans.		‖Hannay, James Ballantine, Cove Castle, Loch Long, N.B., and Whitehall Club, S.W.
1889			‖Hanson, Alfred Miall, The Whalley Abbey Printing Co., Ltd., Whalley, near Blackburn
1895			Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on Tees.
1897			Harbord, F. W., Egham, Surrey
1859	Trans.	S. 1865-73 V.P. 73-5 80-2, 92-5 P. 1895-7	‖Harcourt, A. G. Vernon, M.A., D.C.L., LL.D., F.R.S., Cowley Grange, Oxford
1863			‖Harcourt, L. F. Vernon, M.A., Haddon House, Weybridge
1887	Proc.		‖Harden, Arthur, M.Sc., Ph.D., 20, Kensington-crescent, W.
1885			Hards, William Benjamin, B.A. Lond., Science and Art Department, South Kensington, S.W.

Date of Election.		
1892		Hardy, J. Gordon, c/o The Mexican Gold and Silver Recovery Co., P.O. Box 48, Hermosillo, Sonora, Mexico
1897		Harger, John, B.Sc., Ph.D., c/o Miss Petchell, 30, Jalland-street, Hull.
1898		Hargreaves, A. F., Esk Hill, Roslin, Midlothian, N.B.
1876		Hargreaves, James, Peel House-lane, Farnworth, near Widnes Lancashire
1884		Hargreaves, John, Widnes, Lancashire
1876		‖Harland, R. H., 37, Lombard-street, E.C.
1878		‖Harland, William Dugdale, 48, King-street, Manchester
1897		Harley, Vaughan, M.D., 25, Harley-street, W.
1874		‖Harman, F. E., M.R.A.C., c/o Dr. Piggott, 13, Orchard-gardens, Teignmouth, Devon
1897		Harman, Harold W., Shalmsford, Brixton-hill. S.W.
1899		Harper, H. W., M.D., The University of Texas, Austin, Texas, U.S.A.
1897		Harrie, H. W., c/o Messrs. Harker, Stagg and Morgan, 15 Lawrence Pountney-lane, E.C.
1897		Harrington, B. J., Ph.D., McGill University, Montreal
1881		Harrington, William Bury, Leeview, Montenotte, Cork
1896		Harrington. Wm., 9, Edgehill-terrace, Bransby, Whitehaven
1896		Harris, F. W., Sanitary Chamber, Glasgow
1884		Harris, Frank W., Laboratory, G.W. Ry., Swindon, Wilts
1893		Harris, Harold, c/o Messrs. Dalgety, and Co., Ltd., Sydney, N.S.W.
1895		Harris, Harry, c/o Union Plant, American Smelting and Refining Co., Leadville, Colorado, U.S.A.
1874		Harris, Henry Penley, 15, Coverdale-road, Shepherd's Bush, W.
1894		Harris, Sydney Walters, 15, Lansdowne-terrace, Walters-road, Swansea
1878		‖Harris, Thomas Frederick, B.Sc., Bromley Lodge, Bromley, Kent
1895		Harris, Walter, M.A., Ph.D., Modern and Technical School, Northampton
1888		Harrison, Albert, 72, Windsor-road, Forest Gate, E.
1895		Harrison, C. E., B.A., Abbey View, Potters-bar, N., and St. George's-house, Eastcheap
1894	Trans.	Harrison, Edward Frank, 3, Carlton-avenue, Greenhithe, Kent
1883		‖Harrison, Hugh Erat, B.Sc., 3, Park-road, Clarence Gate, N.W. and Faraday-house, Charing Cross-road
1888		Harrison, J. Burchmere, Government Laboratory, British Guiana
1891		Harrold, Frederick W., 18, Maddox-street, W.
1876	Trans.	Harrow, G. H., Ph.D., Messrs. Allsopp and Sons' Brewery, Burton-on-Trent
1886		Hart, Bertram Harvey, The Elms, Old Charlton, Kent, S.E.
1869	Trans.	‖Hart, F. W., Holly House, 96, Stoke Newington-road, N.

Date of Election.			
1900			Hart, H. W., 13, Lynwood-villas, Darwen, Lancs.
1891			Hart, William Beaumont, Laboratory, 18, Exchange-street, Manchester
1882			Hartley, Arthur, The Brewery, Emsworth, Hants.
1897			Hartley, E. G. J., B.A., Wheaton-Aston Hall, Stafford
1899			Hartley, H. B., B.A., Balliol College, Oxford
1897			Hartley, Thomas, Patwell-street, Bruton, Somerset
1866	Trans.	C. 1877-9 V.P. 90-3	Hartley, Walter Noel, Prof., F.R.S., Royal College of Science, Stephen's-green, Dublin; and 36, Waterloo-road, Dublin
1890	Proc.		Hartog, P. J., B.Sc., Owens College, Manchester; and 22, Brondesbury-villas, London, N.W.
1898	Trans.		Hartridge, Alfred, B.A., 54, Holywell, Oxford
1900	Trans.		Harvey, A. W., 13, Pendrell-road, St. Catherine's-park, Hatcham, S.E.
1885			Harvey, Ernest Wm., A.R.S.M., 20, Malwood-road, Balham, S.W.
1881			Harvey, Sidney, Canterbury
1894			Harvey, W. Pellew,
1875			Hastings, Henry Mitchell, 54, Edith-road, West Kensington, W.
1894			Hatfield, J. Adams, 89, Bridge-street, Wednesbury
1892			Hatton, William Percy, c/o W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred E., M.D. Bruss., L.R.C.P. Edin., 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, E., M.Sc., 6, Stanley-villas, Runcorn, Cheshire
1898			Haworth, John, 32, Marriott-road, Millhouses, near Sheffield
1887			Hay, Alexander, 93, Culford-road, N.
1894			Hayward, Edward Stanley, 5, Alexandra-road, Norbiton, Surrey
1887			Head, C. James, F.I.C., 117, Bedford-road, Clapham, S.W.
1881			Head, Harold Ellershaw, 23, Rugby-mansions, Addison-bridge, W.
1891			Heath, John William, 33, Upper Gloucester-place, W.
1898			Heaton, John, 3, Belle Vue-park, Sunderland
1899			Hedley, G. W., M.A., Boyne House, Cheltenham
1876		C. 1895-9	Hehner, Otto, 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1890	Proc.		Heller, William M., B.Sc.,
1875			‖Hellon, Robert, Ph.D., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, Simonstone, 27, Hammelton-road, Bromley, Kent
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, J. W., 3, Tavistock-road, Croydon
1893			Hemborough, James, Leeds Southern Higher Grade School, Leeds
1898			Hemmy, A. S., Prof., B.A., M.Sc., Government College, Lahore, India

Date of Election.			
1885	Trans.		Henderson, George G., Prof., M.A., D.Sc., F.I.C., the Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, B.Sc., Ph.D., 193, Blackness-road, Dundee
1892			Hendrick, James, B.Sc., F.I.C., Marischal College, Aberdeen
1899	Trans.		Henry, T. A., 37, Chelsea-gardens, S.W.
1853			Hepburn, J. G., LL.B., Dartford, Kent
1897			Heppenstall, Charles, 95, Crompton-road, Handsworth, Birmingham
1885			Hepworth, T. Cradock, 10, Lysias-road, Balham-hill, S.W.
1895			Heriot, T. H. P., Usine, St. Madeleine, San Fernando, Trinidad, B.W.I.
1871			Herman, Douglas, Eccleston-park, Prescot
1876	Trans.	C. 1892-3	Heron, John, 110, Fenchurch-street, E.C.
1892	Trans.		Hewitt, John Theodore, M.A., D.Sc., Ph.D., 65, Silverdale, Sydenham, S.E.
1892			Hewlett, John C., 40, Charlotte-street, Great Eastern-street, London, E.C.
1883	Trans.	C. 1897.	||Heycock, Charles T., M.A., F.R.S., 24, Fitzwilliam-street, Cambridge
1890			Heywood, Joseph H., 231, Drake-street, Rochdale
1848			Heywood, J. S. C., 19, Inverness-terrace, Kensington-gardens, W.
1876	Trans.		Hibbert, Walter, 101, Goldhurst-terrace East, South Hampstead, N.W.
1894			Hichens, J. H., M.A., F.G.S., The School House, Wolverhampton
1881			||Hiddingh, Michael, Newlands, near Capetown
1894			Higgs, M. S.,
1882			||Hill, Alexander,
1858			Hill, Alfred, M.D., F.I.C., F.R.S.E., Medical Officer of Health. The Council House, Birmingham
1896	Trans.		Hill, A. Croft, B.A., 40, Telford-avenue, Streatham-hill, S.W.
1896			||Hill, C. A., 15, Brunswick-gardens, Kensington, W.
1896			Hill, E. G., Prof., B.A., Muir College, Allahabad
1897			Hill, Sydney, 11, Salisbury-street, Hull
1894			||Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, London, S.W.
1892			||Hills, Harold F., 147, Bow-road, London, E.
1898			Hills, T. H., 6, Eliot Park, Blackheath, S.E.
1873			||Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, J. W., 15, Fawcett-street, S.W.
1892			Hinnell, Henry Leonard, 41, Corporation-street, Manchester

Date of Election.			
1894			Hirsch, C. T. W., M.D., Charlinch, Rectory-road, Woolwich, S.E.
1870			Hislop, G. R., Gasworks, Blackstoun-road, Paisley
1886			Hislop, Lawrence, 33, Slatey-road, Birkenhead
1898			Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, R. F., Craigielea, Paisley
1883			‖Hobbs, Bedo, 75, High-street, Maidenhead
1884			Hodges, Herbert J., Dagmar, Napier-avenue, Fulham, S.W.
1882	Trans.		‖Hodgkin, John, F.L.S., F.I.C., 12, Dynevor-road, Richmond, S.W
1879	Trans.	C. 1883-4	Hodgkinson, W. R. Eaton, Prof., Ph.D., F.R.S.E., 18, Glenluce-road, Blackheath, S.E.
1886			Hodgson, Christopher, High House, Eppleby, Darlington
1898			Hodgson, H. McAlpin, Caldew Bank, Cummersdale, near Carlisle
1873			‖Hodgson, H. Tylston.
1894			Hogg, A. F., M.A., 13, Victoria-road, Darlington
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D., 62, Avenue des Champs Elysées, Paris
1876			Holcroft, Harold, M.A., Parkdale, Wolverhampton
1885			Holgate, Thomas, Rawson-avenue, Greenroyd, Halifax
1876			Holland, Philip, 22, Taviton-street, Gordon-square, W.
1880			Holliday, Robert, c/o Messrs. Read, Holliday and Sons, Limited, Huddersfield
1891			Holloman, Frederick R., Southern-road, Plaistow, E.
1886			Holloway, George Thomas, 57 and 58, Chancery-lane, W.C.
1895			Holme, A. E., M.A., The Wheelwright Grammar School, Dewsbury
1897			Holmes, John, Government Laboratory, Clements Inn Passage, W.C.
1886			Holmes, John Winder, Ruyton-xi-towns, Shropshire
1898			Holroyd, G. W. F., B.A., Christ Church, Oxford
1893			Holthouse, H. B., 12, Melton-grove, West Bridgford, Notts.
1898			Homfray, David, B.Sc., 6, Dartmouth-row, Greenwich, S.E.
1878			Hooker, A. H., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel C., Spreckel's Sugar Refining Co., Reed-street, Philadelphia, U.S.A.
1883			‖Hooper, David, Curator, Economic and Art Section, 1, Sudder-street, Indian Museum, Calcutta
1888			Hooper, E. Grant, 16, Royal-avenue, Chelsea, S.W.
1891			‖Hooper, Ernest F., Wear Fuel Works, South Dock, Sunderland
1894			‖Hornby, R., M.A., Marsh Parade, Newcastle, Staffordshire
1897			Horseman, J. W., County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1892			Horwill, Edgar E. C., 19, Devereux-road, New Wandsworth, S.W.

Date of Election.			
1886			‖Hoskins, Arthur Percy, 25, Cromwell-road, Belfast
1882			Hotblack, Herbert A., Cannon Brewery, Brighton
1871			Houlder, W. W., 10, Ossulton-villas, Southall-green, Southall
1887	Proc.		Houlding, William, B.Sc., Gilmerton, Cressington-park, Liverpool
1900			Houston, Adam, Brisbane House, Bellahouston, Glasgow
1896			Howard, Albert, Government Laboratory, Barbados, W.I.
1882			‖Howard, Alfred G., Burnt House, Chigwell, Essex
1869			Howard, Alfred Kingsby, 2, Winchester-road, South Hampstead, N.W.
1870		C.1875-8 83-4, 98- V.P.86-8	‖Howard, David, Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, D. Lloyd, jun., Little Friday Hill, Chingford, Essex
1889			Howard, George William, Calverley, Tunbridge Wells
1875			Howard, Thomas, 50, Ellington-street, Liverpool-road, N.
1882			Howe, J. Lewis, M.D., Ph.D., Prof. of Chem., Washington and Lee University, Lexington, Va., U.S.A.
1889			Howe, Walter, 45, Spring-gardens, Bradford
1880			Howell, Reginald, 95A, Southwark-street, S.E.
1876			Howie, W. L., Hanover Lodge, West Hill, Harrow.
1889			‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889			Hoyles, Henry Richardson, c/o Messrs. Treacher and Co., Byculla, Bombay, and Fern-place, 142, Upperthorpe, Sheffield
1871			‖Hudleston, W. H., M.A.,
1878			Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899			Hübner, Julius, 24, Delauney's-road, Crumpsall, Manchester
1894			Hughes, Frank, 78, Duke-street, Chelmsford
1880	Trans.		Hughes, George Henry, Analytical Laboratory, Barbados, West Indies; and 155, Fenchurch-street, E.C.
1868			Hughes, John, Analytical Laboratory, 79, Mark-lane, E.C.
1896			Hughes, J. A., 1, Bridewell-street, Bristol
1885			Hughes, T. Vaughan, Norwich Union-chambers, Congreve-street, Birmingham
1882			Hughes, Thomas, Borough Analyst, West Wharf, Cardiff Laboratory, 31, Londoun-square, Cardiff
1879	Trans.		Hummel, J. J., Prof., The Yorkshire College, Leeds
1883			Humphrys, Norton H., 4, The Paragon, Wilton-road, Salisbury
1869			Hunt, Charles, Birmingham Gas Light Works, Windsor-street, Birmingham
1883			Hunter, John, 29, Chambers-street, Edinburgh
1885			Hunter, Matthew, M.A. Oxon, Cowside, Settle, Yorks.
1878			Huntington, A. K., Prof., Metallurgical Laboratory, King's College, W.C.

Date of Election.		
1893	Trans.	Huntly, George Nevill, B.Sc., 96, Gower-street, W.C., and 56, Sheen-road, Richmond
1885		Hurst, George H., 22, Blackfriars-street, Salford
1861		Huskisson, H. O., 5, Gordon-square, London, W.C.
1900		Hutchin, H. W., Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, B.A., B.Sc., Bryn-y-Mor, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A., Ph.D., Pembroke College, Cambridge
1884		Hutchinson, C. Clark, 8, Cleve-road, Hampstead, N.W.
1888		Idris, Thomas Howell Williams, Pratt-street, Camden Town N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1892	Trans.	Ince, Walter H., Ph.D.,
1889	Trans.	Ingle, Herbert, Glaramara, Ridge End, Headingley, near Leeds
1897		Innes, W. R., Ph.D., M.Sc., Mason College, Birmingham
1871		Irvine, Robert, Royston, Granton, near Edinburgh
1883		‖Irwin, Wilfred, 3, Wilton Polygon, Cheetham Hill, Manchester
1892		‖Isaac, John F. V.,
1882		Isherwood, Thomas, M.A., LL.D., D.C.L., University School, Southport
1885		Ivatt, Albert, M.A., "The Engadine," Histon, Cambridge
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex
1883		‖Jackson, A. Henrick, Prof., B.Sc., The Electrical Engineering School, 358, Collins-street, Melbourne, Australia
1894	Trans.	Jackson, David Hamilton, M.A., B.Sc., Ph.D., University College, Bristol
1882		Jackson, Edward, Clovelly, Grove Avenue, Moseley, Birmingham
1900	Trans.	Jackson, Henry, B.A., B.Sc., Downing College, Cambridge
1884	Trans.	Jackson, Herbert, Chemical Laboratory, King's Coll., Strand, W.C.
1892		Jackson, John, Llangorse Villa, Serpentine-road, Gold Tops, Newport, Mon.
1883		Jackson, Robert, 18, Harrington-street, Dublin
1881		‖Jackson, R. Valentine, c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892		Jackson, Samuel, c/o Messrs. Binney and Co., Madras
1887		‖Jadhava, K. B., Nowasari, Bombay Presidency, India
1878	Trans.	Jago, William, F.I.C., Godrevy-house, Wilbury-avenue, Hove, Brighton, and Cornwall-buildings, 35, Queen Victoria-street, E.C.
1895		James, Alfred, 56, New Broad-street, E.C.
1888		‖James, Christopher, Messrs. Elliott's Metal Company, Burry Port, South Wales
1878		Jamieson, Alexander, 5, St. Mark's-crescent, Regent's Park, N.W.

Date of Election			
1879	Trans.	C.1882-4 F.S. 85-91 V.P.95-9	†‖Japp, F. R., M.A., LL.D., F.R.S., University, Aberdeen
1882			J'Armay, Gustav, Hartford Lodge, Hartford, Cheshire
1898			Jarvis, G. A., The Shrubbery, Snedshill, Wellington, Salop
1898			Jee, E. C., B.Sc., 39, Pepys-road, New Cross, S.E.
1896			Jeffers, E. Haynes, 87, Kyrle-road, West Side, Clapham Common, S.W.
1891	Trans.		Jenkins, Henry Charles, Government Dept. of Mines, Melbourne, Australia
1892			‖Jenkins, John H. B., Chemical Laboratory, G.E. Ry. Works, Stratford, E.
1896			Jenkins, J. P., 30, St. John's-road, Clifton, Bristol
1894			Jenks, R. Leonard, 24, Baskerville-road, Wandsworth Common, S.W.
1894			Jennison, Francis Herbert, 26, Derby Crescent, Kelvinside, near Glasgow
1896	Trans.		‖Jerdan, D. S., M.A., B.Sc., Ph.D., c/o Messrs. J. and G. Cox, Gorgie Mills, Edinburgh
1898			Jessop, S. M., 84, Horbury-road, Wakefield
1879			Jewson, Francis A. B., 218, Stockwell-road, Brixton, S.W.
1875			‖Johnson, David, F.G.S., F.R.M.S., 1, Victoria-road, Clapham Common, S.W.
1895			Johnson, F. E., Holly House, Cottingham, Hull
1897	Trans.		Johnson, Harold, 5, Boulevard Clovis, Bruxelles
1883			Johnson, James Edward, 40, Edmiston-road, Stratford, E.
1872			Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1886			Johnson, J. T., Durham School, Durham
1897			Johnson, Otis C., Prof., 52, Thayer-street, Ann Arbor, Mich., U.S.A.
1866			‖Johnson, Samuel H., The Warren Hill, Loughton, Essex
1896			Johnstone, James, Braehead, Parkhill, Rutherglen
1892			Johnstone, William George, c/o Messrs. Warwick's, The Brewery, Newark-on-Trent
1898			Jones, Edward, B.Sc., 15, Macaulay-road, Clapham, S.W.
1895			Jones, E. L., The County School, Milford Haven
1871	Trans.		Jones, E. W. T., The Oaklands, Wolverhampton; and 10, Victoria-street, Wolverhampton
1873	Trans.		Jones, Francis, F.R.S.E., Beaufort House, Alexandra Park, Manchester
1894			‖Jones, Geo. Cecil, Basingstoke Ironworks, Basingstoke, Hants
1876	Trans.		‖Jones, H. Chapman, Royal Coll. of Science, S. Kensington, S.W.
1893			Jones, Hedley Gordon, 23, Mount Nod-road, Streatham, S.W.
1878			Jones, Henry Williams, Spencer-park, Coventry

Longstaff Medallist, 1891.

Date of Election.			
1890			Jones, John Archyll, B.Sc., 27, Southfield-road, Middlesbrough
1892	Trans.		Jones, Lionel Manfred, St. Dunstan's College, Catford, S.E.
1899			Jones, L. W., Ph.D., University of Chicago, Chicago, Ill., U.S.A.
1891			Jones, M. William, 8, Cavendish-place, Jesmond, Newcastle-on-Tyne
1896			Jones, R. H., 88, Norwood-road, London, S.E.
1898			Jones, Thomas Hill-, Eagle Wharf-road, New North-road, N.
1895			Joseph, Edgar, 42, Brondesbury-road, Kilburn, N.W.
1893	Trans.		Jowett, Hooper A.D., D.Sc., 20, Kilmorie-road, Forest-hill, S.E.
1891			Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900			Joyce, T. G., B.Sc., The Smallthorns, Stafford
1899			Judge, Thomas, B.A., 43, Foxberry-road, Brockley, S.E.
1893			Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.		Kawakita, Michitada, Engineering College, Tokio, Japan
1898			Kay, R. A., 7, The Causeway, Cambridge
1881	Trans.		Kay, William E., 47, Camphill-street, Queen's-park, Glasgow
1889			Kaye, J. R., M.B., Medical Officer of Health, West Riding of Yorkshire, Wakefield
1883			‖Keeling, Frank, Puritan Brewing Co., Charlestown Dist., Boston, U.S.A.
1882			‖Keen, Austin, Glanbaiden, Trumpington-road, Cambridge
1894			‖Kellas, Alex. Mitchell, B.Sc., 24, Cecile-park, Crouch-hill, N., and University College, W.C.
1874			Kellner, William, Ph.D., Chemical Department, Royal Arsenal, Woolwich, S.E.
1897			Kelly, Charles, The Technical School, Darwen, Lancs.
1867			‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882			Kemp, William Joel, Mountfield, Robertsbridge, Sussex
1884			Kendall, George Frederic, B.A., The Hollies, Stratford-upon-Avon
1874			Kendall, James Alfred, Lonesome Chemical Works, Streatham Common, S.W.
1889			Kenwood, Henry R., M.B., C.M. (Edin.), L.R.C.P. (Lond.), 9, Alexandra-villas, Finsbury Park, N.
1895			Kenyon, Rich. E., M.Sc., The Grammar School, Great Yarmouth
1883			Kerry, William H. R., The Sycamores, Windermere
1895			Kibble, W. O., Golden Eagle G.M. Co., Hayden-hill, Larsen Co., California, U.S.A.
1882			Kilner, Frederick James, 1, Abbotsford-place, Leopold-street, Leeds
1884			Kilpatrick, W. Stirling, 6, Colebrook-street, Hillhead, Glasgow
1872	Trans.	C. 1887-92	‖Kinch, Edward, Prof., Royal Agricultural College, Cirencester
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield

Date of Election.			
1897			King, Herbert, B.Sc., Ashville College, Harrogate.
1876			King, J. Falconer, Laboratory of City Analyst, Edinburgh
1895			Kingdon, G. Holman, M.A., c/o Messrs. Crosfield, Limited, Warrington, and Ivy Lodge, Froghall, Warrington.
1872	Trans.		‖Kingzett, Charles T., Elmstead Knoll, Chislehurst, Kent
1896			Kinnersley, H. W., 4, The Avenue, Keynsham, Somerset
1895			‖Kinnicut, Prof. L. P., 77, Elm-street, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	‖Kipping, F. Stanley, Prof., Ph.D., D.Sc., F.R.S., University College, Nottingham
1886			Kirby, Herbert E., St. Margaret's Mansions, Victoria-street, S.W.
1890			Kirk, Oliver, 19, Carlton-road, Workington
1895			‖Kirkaldy, Patrick H., Chemical Department, King's College, W.C.
1873			‖Kitchin, Archibald, F.I.C., Scragill House, Whitehaven
1889			Kitchin, John, The Middlesex Hospital, W.C.
1888			‖Knaggs, Alfred Battye, 2, Bradley-lane, Huddersfield
1889			Knight, Frederick Charles, Boston and Colorado Smelting Company, Argo, Colorado, U.S.A.
1894			Knight, James, M.A., B.Sc., St. James's School, Carlton, Glasgow
1896			Knight, J. B., Bushwood, Wanstead, Essex
1894			Knight, Wm. Albt., Sexey's Trade School, Bruton, Somerset
1878			Knights, James West, County Laboratory, Cambridge
1879			Knowles, Joshua, Stormer-hill, Tottington, Bury
1892			Knowles, Thomas Torrens, M.A. (Cantab.), 27, Peel-street, Princes Park, Liverpool
1864			Knox, G. W., B.Sc., 16, Finsbury-circus, London, E.C.
1873			Koch, Walter Edward, M.A., F.G.S.,
1887	Trans.		Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1886	Trans.		Kohn, Charles A., Ph.D., B.Sc., 20, Mulgrave-street, Liverpool
1885			Koningh, Leonard de, 4, St. Martin's Road, Stockwell, S.W.
1892			Krause, Dr. G., Cothen, Germany
1859	Trans.		Kynaston, Josiah W., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900			Kynaston, W. C. R., 9, Harland-road, Higher Tranmere, Birkenhead
1894			Ladell, R. S., 67, Church-road, Tranmere, Birkenhead
1888			Lafosse, Charles R., 37, Whiteladies'-road, Clifton, Bristol
1893			Lamb, Edmund George, M.A., Borden Wood, Liphook, Hants.
1892	Trans.		‖Lamb, Thornton Charles, 13, Berners-street, Oxford-street, W.
1893			Lambert, Wesley J., 55, Plumstead Common-road, Plumstead, S.E.
1877			Lancaster, William James, F.R.A.S., F.R.C.S., F.R.M.S., The Hollies, Handsworth Wood, Birmingham
1886			Lang, William, Cross Park, Partick

Date of Election.			
1897	Trans.		Lang, W. R., D.Sc., 9, Crown-gardens, Glasgow
1896			Lange, E. F. S., Sunny Nook, Victoria-road, Withington, Manchester
1885			Langer, Charles, Ph.D., Ynyspenllwch, Clydach, R.S.O., Glamorganshire.
1891			‖Langham, Rev. E. Norman, M.A. (Cantab.), F.L.S., Head Master, Rastrick Grammar School, Brighouse
1894	Trans.		Lapworth, Arthur, D.Sc., 17, Bloomsbury-square, W.C.
1883			Lascelles, B. P., B.A., Longridge, High-street, Harrow-on-the-Hill
1897			Lasseter, W. J. G., M.A.,
1880			Last, Frank B., Laboratory, 78, Mansell-terrace, Swansea
1891	Trans.		Lauder, Alexander, University College, Bangor, North Wales
1886	Trans.		Laurie, Arthur P., Monk Wood Cottage, Baldwin Hill, Loughton
1899			Laurie, D. Northall, 18, Albion-street, Hyde-park, W.
1876			‖Law, Channell, Ilsham Dene, Torquay
1896			Law, H. E., 2304—6—8, Van Nesse-avenue, San Francisco, U.S.A.
1890	Trans.		Law, Robert, F.I.C., The Royal Mint, Melbourne
1850	Trans.	C. 1862-5	‖Lawes, Sir John Bennet, Bart., D.C.L., D.Sc., F.R.S., Rothamsted, near St. Albans
1896	Trans.		Lawrence, W. Trevor., B.A., Ph.D., 57, Prince's Gate, S.W., and Owens College, Manchester
1900			Laws, A. R., 48, Waverley-terrace, Newcastle-on-Tyne
1882			Laws, J. Parry, F.I.C., Westfield, Bath-road, Worcester
1888	Trans.		‖Lawson, Thomas Atkinson, Ph.D., B.Sc., 90, Boundary-road, London, N.W.
1890	Trans.		‖Laycock, William Frederick, Ph.D., 46, Boar Lane, Leeds
1890			Lea, A. Sheridan, D.Sc., F.R.S., Caius College, Cambridge
1886			‖Leach, Walter, 21, St. Andrew's-place, Bradford
1894	Trans.		‖Lean, Bevan, D.Sc., B.A., Laurel Bank, Ackworth, near Pontefract
1888			Lease, Frank E., Melapi Estate, Sandakan, British North Borneo
1891	Trans.		Leather, J. Walter, Ph.D., Dehra Dunn, N.W.P., India.
1889			Ledingham, L. Napier, Govandale, Elmore-road, Sheffield
1883			Lee, Herbert C., The New Westminster Brewery Company, Earl-street, Horseferry-road, S.W.
1898			Lee, H. L., Chemical Instructor, Rajkot, Kathiawar, Bombay
1883			Lee, Robert Brewer, B.Sc., B.A., 6, Warwick-street, Kensington, W.
1897			Lee, T. H., St. John del Rey Mining Co., Ltd., Morro Villeo, Villa Nova de Lima, Estada de Minas, Geras, Brazil
1891			Leeds, Frank H., 26, East Bank, Stamford-hill, N.
1899			Leeming, W. T., Higher Grade School, Pentre, Glam.

Date of Election.			
1873			Lees, Charles, Devonshire House, Bridlington Quay, Yorks.
1891			Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889			‖Legg, John Edmund, M.A., F.I.C., The Grammar School, Woodbridge, Suffolk
1891	Proc.		Leicester, James, Ph.D., Technical College, Derby
1889			Leigh, Cecil, Birmingham Metal and Munitions Company, Adderley Park Rolling Mills, Birmingham
1897			Lemmey, Tom, Rev., B.A., Wellington College, Berks
1891			Lennox, Robert N., The Nook, Rose Bank, Crabb Tree, Fulham
1899			Leon, A. A., Messrs. Abbey & Sons, Bristol Brewery, Seymour-street, Brighton
1894			Leonard, Norman, B.Sc., 61, Wolfington-road, West Norwood, S.E.
1882			Lescher, Frank Harwood, 60, Bartholomew-close, E.C., and 31, Devonshire-place, W.
1895	Trans.		Le Sueur, Henry Rondel, B.Sc., St. Thomas's Hospital, S.W.
1896			Lethbridge, W. A., 16, Barclay-road, Fulham, S.W.
1899			Lett, S. J., 25, Percy-street, Liverpool, and c/o The North Charterland Exploration Co., Ltd., Fort Young, via Kota-Kota, British Central Africa
1879	Trans.		Letts, Edmund Albert, Prof., D.Sc., Ph.D., Queen's College, Belfast
1888	Trans.		Lewes, Vivian B., Prof., 19, Park-row, Greenwich, S.E.
1898			Lewins, William, B.Sc., Higher Primary School, Technical Institute, Blackburn
1884			Lewis, A. E., B.A., F.I.C., 2, Mulgrave-street, Liverpool
1899			Lewis, E. W., 64, Ommaney Road, New Cross, S.E.
1894	Trans.		Lewis, W. H., Exeter School, Exeter
1869	Trans.		‖Lewis, W. J., New Museums, Cambridge
1888	Trans.		Lewkowitsch, Julius, Ph.D., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, T., Chemical Works, Silvertown, E.
1896			Lidgey, C. R., 11, St. Peter's-road, Harborne, Birmingham
1892			Lindley, Hubert Edward, Rose Villa, Pinner-road, Harrow
1899			Lindsay, R. W., 22, Hilldrop-crescent, Camden-road, N.
1886	Trans.		Ling, Arthur R., 45, Lambton-road, Cottenham Park, Wimbledon
1899			Linstead, E. F., 9, Church-road, Brixton Hill, S.W.
1896			Littlefield, R. D.,
1853	Trans.	V.P. 1883-6, 1898-	‖Liveing, G. D., Prof., M.A., F.R.S., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof., F.R.S., University, Sydney, New South Wales
1883			Livingston, W. J., London County Council, Spring-gardens, S.W.
1880	Trans.		‖Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.		Lloyd, F. J., Agricultural Laboratory, 4, Lombard-court, E.C.

Date of Election.		
1893		Lloyd, Herbert, The Electric Storage Battery Co., Allegheny Avenue, Philadelphia, U.S.A.
1896		Lloyd, T. H., Penygraig, Pontypridd
1896		Lockwood, T. W., Heckmondwike, Yorkshire
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1884		London, J. Edward, M.D., 62, Main-street, George Town, Demerara, W.I.
1872		‖Longstaff, George Blundell, M.A., M.B. Oxon., M.R.C.P., Highlands, Putney Heath, S.W.
1873		‖Loram, H. Y., 49, Buxton-road, Chingford, Essex
1878	Trans.	‖Louis, D. A., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward G., Ph.D., 80, East 55th-street, New York, U.S.A.
1882		‖Lovibond, Thomas Watson, F.I.C., The Tyne Brewery, Newcastle-on-Tyne
1884		Low, Charles William, M.B., Stricklands, Stowmarket, Suffolk
1878		‖Lowe, Walter Bezant. M.A., Stranraer School, Fareham, Hants
1876		Lowe, William Foulkes, A.R.S.M., 9 Hough-green, Chester
1898	Trans.	Lowry, T. M., B.Sc., 10, Oxford-gardens, North Kensington, W.
1899		Lucas, Alfred, Survey Department, Public Works Ministry, Cairo, Egypt
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, and Southville, Swansea
1877	Trans.	‖Luff, A. P., M.D., B.Sc. (Lond.), 31, Weymouth-street, Cavendish-square, W.
1890	Trans.	Lumsden, John S., B.Sc., Ph.D. (Mun.), 5, Paradise-road, Dundee
1867	Trans.	‖Lunge, Dr. George, Englischviertelstrasse 22, Zürich, Switzerland
1890	Trans.	Lunt, Joseph, B.Sc., Royal Observatory, Cape of Good Hope
1872	Trans.	‖Lupton, Sydney A., Audley Mansions, 44, Mount-street, W.
1893	Trans.	Luxmoore, Charles M., D.Sc., University Extension College, and Kennet View, Mansfield-road, Reading
1899		Luxton, Thomas, B.A., B.Sc., 19, Spring-street, Hull
1873		Lyon, I. B., Brigade Surgeon, Lieut.-Col., C.I.E., East India U.S. Club, 16, St. James's-square, S.W., and 164, Sutherland-avenue W.
1874		Lyon, J. G., The Aire Tar Works, Knottingley, Yorks
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72 Brainard-street, Detroit, Mich., U.S.A.
1859		‖Lyte, F. Maxwell, M.A. (Cantab.), F.I.C., A.I.C.E., Hon.F.P.P.S., 60, Finborough-road, South Kensington, S.W.
1888		Maben, Thomas, West of Scotland College of Pharmacy, 157, St. Vincent-street, Glasgow
1878		Macadam, C. T., South Cliff Hall, Cliftonville, Bournemouth

Date of Election.		
1896		Macadam, H. E., Odam's Wharf, Victoria Docks, E.
1853		Macadam, Stevenson, Prof., Ph.D., F.R.S.E., Surgeons' Hall, Edinburgh
1888		‖Macadam, Stevenson, J. C. G., jun., Surgeons' Hall, Edinburgh
1878		Macadam, W. Ivison, F.R.S.E., Professor New Veterinary College, Surgeons' Hall, Edinburgh
1886		Macan, Hugh, M.A., County Hall, Kingston-on-Thames
1890		‖MacArthur, J. Stewart, 45, Renfield-street, Glasgow
1897		MacCulloch, Charles, Ballarat Club, Ballarat, Victoria
1894		Macdonald, A. H., 81, Cambridge-street, Eccleston-square, S.W.
1894	Trans.	MacDonald, G. W., M.Sc., Cobden House, Dartford, Kent.
1891		MacDonald, William G., c/o Dr. C. C. Stuhlmann, Tung Wen Kwan, Peking.
1886		MacEwan, Peter, 37, Hornsey-lane Gardens, N.
1895		MacFarlane, Alex., 149, Manx-terrace, Blackley, Manchester
1880		Macfarlane, James A.,
1891		Macfie, R. A. Scott, M.A. (Cantab.), B.Sc., 34, Moorfields, Liverpool
1890		Macintyre, Alfred E., Morrin College, Quebec, P.Q., Canada
1887		Mackay, Angus,
1890		Mackean, William, 14, Palmer-street, Westminster, S.W.
1874		Mackenzie, D. C.,
1897		Mackenzie, J. E., B.Sc., Ph.D., Birkbeck Institution, Chancery-lane, E.C.
1896		Mackenzie, Thomas, 4, Church-street, Inverness
1892		Mackenzie, Dr. William Cossar, Tewfikieh College of Agriculture, Gheezeh, Cairo
1897		Maclaurin, J. S., D.Sc., Woodside-road, Mount Eden, Auckland, N.Z.
1899		MacLeod, James, West Hill, Cardross-road, Dumbarton
1879		‖Macmillan, J. Laker,
1897		Macmullen, Alan, B.A., 82, James-street, Dublin
1881		MacMunn, Charles A., M.A., M.D., F.R.M.S., Oakleigh, Wolverhampton
1880		Macnab, William, Edinburgh Lodge, Howick-place, Victoria-street, Westminster, S.W.
1885	Trans.	‖Macnair, Duncan Scott, Ph.D., B.Sc., 10, Maxwell Drive, Glasgow
1888		MacSwiney, E.,
1864	Trans.	‖Mactear, James, F.R.S.E., 28, Victoria-street, Westminster, S.W.
1862	Trans.	Madan, H. G., Bearland House, Gloucester
1896		Main, Hugh, B.Sc., 45, The Village, Old Charlton, Kent
1892		Major, George Harry, Devonshire-street, Ardwick, Manchester

Date of Election.			
1894			Makin, C. J. Shaw, 51, Earl's-court-square, S.W.
1885			‖Mallet, F. R., 18, The Common, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, J. W., Prof., Ph.D., M.D., F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, W. L., Gawthorp-green, Kirkheaton, near Huddersfield
1896			Manners, Hugh, M.A., B.Sc., Academy House, Airdrie, N.B.
1858			‖Manning, F. A., 18, Billiter-street, E.C.
1897			Mansford, C. J., B.A., Lady Manner's Grammar School, Bakewell
1895			‖Marchant, Robert Charles, P.A.S.I., M.R.A.C., 103, High-street, Andover, Hants.
1896			Marks, E. S.,
1893	Trans.		Marsden, Fred, M.Sc., Ph.D., Taitlands, Swinton grove, C.-on-M., Manchester
1881			‖Marsh, Charles W., Ph.D.
1883	Trans.		Marsh, J. E., M.A., University Museum, Oxford
1895			Marshall, Arthur, Laboratory, Leadenhall House, 101, Leadenhall-street, E.C.
1890	Trans.		Marshall, Hugh, D.Sc., F.R.S.E., Chemical Department, University of Edinburgh
1896			Marshall, P. S., Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, 13, Clovelly-road, South Ealing, W,
1890	Trans.		Marshall, T. Rhymer, D.Sc., 19, Sandyford-place, Glasgow
1888	Trans.		Marshall, William, 35, Streathbourne-road, Balham, S.W.
1887			Marshall, William, F.I.C., 149, Drake-street, Rochdale
1893			Martin, Alexander Mitchell, Douglas Villa, Dunbeth-road, Coatbridge
1897			Martin, C. H., 14, Aldred-street-crescent, Salford
1898			‖Martin, G. H., M.A., 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Lieut.-Col. Gerald Ward, F.R.G.S., 8, Petersham Terrace, Gloucester-road, S.W.
1899			Martin, S. M., 9, Churchill-terrace, Sandymount, Dublin
1883			Martin, W. H., 183, King's-road, Chelsea, S.W.
1870			‖Martindale, William, 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C., and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Northwood, Rydal-road, Streatham, S.W.
1898			Mascarenhas, J. C., Frenches, Shaftesbury-road, Forest Gate, E.
1851	Trans.	C. 1858-9, 75-6 V.P. 78-80	Maskelyne, Nevil Story, F.R.S., Salthrop, Wroughton, Wilts
1890			Mason, Francis H.,
1893			Mason, James, M.D.,
1858			‖Mason, James, Eynsham Hall, Witney Oxon

Date of Election.			
1889			Mason, James Braik, The West End Laboratory, Dundee
1880			Mason, William Brandwood, 117, Derby-street, Bolton
1882	Trans.		Masson, Orme, M.A., D.Sc., Prof., The University of Melbourne, Victoria
1897			Masters, Edward, The Aloes, Hinckley-road, Leicester
1873			‖Masters, William, 82, Oxford-gardens, North Kensington, W.
1897			Mathews, J.A., M.A., M.Sc., 4, First-place, Brooklyn, N.Y., U.S.A.
1896			Mathieson, L. W., North Wilts Technical School, Swindon
1876	Trans.		‖Matthews, C. G., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1880	Trans.		Matthews, Francis Edward, Ph.D., Royal Indian Engineering College, Cooper's Hill, Staines, and Treberfydd, Englefield Green, Surrey
1884			‖Matthey, Edward, 78, Hatton-garden, E.C.
1870		C. 1877-8	Matthey, George, F.R.S., 78, Hatton-garden, E.C.
1899			Maudsley, Joshua, Bank Buildings, Settle, Yorks.
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. Camb., B.Sc. Lond., 29, Woolwich-common, S.E.
1896			Mayfield, A. S., Avenue House, Beverley-road, Hull
1899			McAlley, James, The Scottish Cyanide Co., Ltd., Leven, Fife, N.B.
1887			‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1888			McBretney, Edmund G., Pontefract-road, Castleford, York
1890			McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1899	Trans.		McConnell, Arthur H., 35, Bernard-street, Russell-square, W.C.
1899			McConnell, William, 178, Springfield-road, Glasgow
1896			‖McConnell, William, jun., c/o Prof. P. Phillips Bedson, Durham College of Science, Newcastle-on-Tyne
1875			‖McCowan, William, F.I.C., 44, Alexandra-road, Gipsy Hill, S.E.
1896			McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.		McCrae, John, jun., Ph.D., The Yorkshire College, Leeds
1895			McCreath, James, Auchenwinn, Maybole, Ayr, N.B.
1899			McCreath, W. D., The Plains, Totnes, South Devon
1890			‖McCubbin, William A., 35, The Temple, Dale-street, Liverpool
1894			McCutcheon, Jas., Glencorra, Lanark
1874			McDougall, John, Clifton House, Greenwich Park, S.E.
1898			McEwen, A. F.
1895			McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.		McGowan, George, Ph.D., 3, Mount-avenue, Ealing, W.
1893			McGregory, Joseph Frank, Prof., Colegate University, Hamilton, New York, U.S.A.
1893			McKerrow, Charles Alexander, 8, Exchange-street, Manchester

Date of Election.			
1892			McKerrow, William James, D.Sc., Messrs. Field and Co., Upper Marsh, Lambeth, S.W.
1868	Trans.	C. 1871-3 80-3 95-9 V.P. 87-90	‖McLeod, Herbert, Prof., F.R.S., Indian Civil Engineering College, Cooper's Hill, Staines
1894			McLeod, Jas., 5, Gladstone-terrace, Paisley
1889	Trans.		‖McMurtry, George Cannon, Cobar Copper Works, Lithgow, N.S.W.
1895			McVey, W. B., Professor
1892			Meacham, Chas. Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, S.A.
1898			Meads, C. J., 42, Flanders-road, Bedford-park, W.
1896			Meggitt, Loxley, The Laboratory, Sutton-in-Ashfield, Notts.
1871	Trans.	C. 1883-6, 90-91 F.S. 91-	‖Meldola, Raphael, Prof., F.R.S., 6, Brunswick-square, W.C.
1895			Meldrum, Robt.,
1894			Melland, Godfrey, B.Sc., Mason College, Birmingham
1875			Melmore, Pattinson B., Chemical Laboratory, Maryport
1900			Menzies, A. W. Cranbrook, M.A., B.Sc., 11, Howe-street, Edinburgh
1884			Mercer, Francis M., 89, Bishopsgate-street-within, E.C.
1889			Mercer, Thomas, Great Hey, Edenfield, near Bury, Lancashire and Ring Bank Brewery, Edenfield, near Bury
1896			Merrett, W. H., Hatherley, Grosvenor-road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland Park, Sheffield
1897			Merson, G. F., 24, Newgate-street, Newcastle-on-Tyne
1876	Trans.	C. 1884-7, 1897-	‖Messel, Rudolph, Ph.D., 30, Ebury-street, S.W.
1888	Trans.		‖Miers, Henry Prof., M.A., F.G.S., F.R.S., Magdalen College, Oxford
1892	Trans.		Millar, James Hill, The Brewing School, Mason University College, Birmingham
1843			‖Millar, James,
1891			‖Millard, Edgar J., F.R.M.S., Elyne House, Elyne-road, Stroud Green, N.
1880	Trans.		‖Miller, A. K., Ph.D., Kilvert's-buildings, Withy-grove, Manchester
1897			Miller, E. H., M.A., Ph.D., Columbia University, New York City, U.S.A.
1889			Miller, Harry East, Ph.D., 1015, Chestnut-street, Oakland, California
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den, North Aberdeen
1887			Miller, John A., M.Sc., Ph.D., Niagara University, Buffalo, New York, U.S.A.
1885	Trans.		‖Miller, N. H. J., Ph.D., Harpenden, Hertfordshire

Date of Election.			
1898			Miller, W. Lash, B.A., Ph.D., 100, St. Vincent-street, Toronto, Canada
1896			Miller, W. M., Caledonia Estate, Wellesley Province, Penang, S.S.
1893	Trans.		‖Mills, Charles, The Maples, 188, Bedford-hill, Balham, S.W.
1862	Trans.	C. 1868-71, 75-6, 80-3	‖Mills, E. J., D.Sc., F.R.S., Young Professor of Technical Chemistry in the Glasgow and West of Scotland Technical College, 60, John-street, Glasgow
1898	Proc.		Mills, W. H., M.A., c/o Fraülein Ochler, Neckarhalde 19, Tübingen, Würtemberg
1885			‖Milne, Alexander, Major I.M.S., M.A., M.B., H.M.'s Mint, Bombay
1877			Milne, G. A., The Poplars, Walkley, Sheffield
1892			Milnes, Ernest E.,
1887			Mingaye, John C. H., Department of Mines, Assay Branch, Sydney, N.S.W.
1899			Mirrlees, Arthur, B.A., Redlands, Kelvinside, Glasgow
1898			‖Mitchell, A. H., B.Sc., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1891	Proc.		Mitchell, Charles Ainsworth, B.A. Oxon., c/o Messrs. Beaufoy and Co., South Lambeth-road, S.W.
1897			Mitchell, Tom, Cemetery House, Shaw, near Oldham
1896			Mitra, Asutosh, Rai Buhadur, Chief Medical Officer, Kashmir
1899			Mohr, Bernard, Ph.D., 69A, Parliament Hill, Hampstead, N.W.
1893			Mole, H. Bloome, Hill Side, Shepton Mallet
1899			Molson, J. Cavendish, 10, Walsingham-terrace, West Brighton
1872	Trans.	C.1884-5 V.P.87-9 94-8	‖Mond, Ludwig, Ph.D., F.R.S., 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A., F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1879			‖Mondy, Edmund F., Principal, Dacca College, Dacca, Bengal
1892			Monson, H. J.,
1887	Trans.	C. 1899-1900	‖Moody, G. Tattersall, D.Sc., Lorne House, North Dulwich, S.E.
1897			Moon, P. G. G., The Laboratory, British Gas Light Co., Ltd., Norwich
1892			‖Moor, Cresacre George, B.A., 4, Dane's Inn, Strand, W.C.
1891			Moore, Frederick Herbert, Strada degli Argentieri, 19, Messina, Sicily
1890			Moore, Ira, Ph.D., 138, Kent-street, Greenpoint, Brooklyn, N.Y., U.S.A.
1896			Moore, L. C., 31, Tunley-road, Upper Tooting Park, S.W.
1895			Morgan, D. J., 10, Northampton-place, Swansea

Date of Election.			
1897			Morgan, F. F. de, 66, Clapham-road, S.W.
1898	Trans.		‖Morgan, G. T., 35*a*, Russell-road, Kensington, W.
1888			‖Morgan, John James, Rooth-street, Wood Green, Wednesbury
1900			Morgan, J., Livingston R., M.A., Ph.D., B.Sc., 47, Bayard-street, New Brunswick, N.Y., U.S.A.
1893			Morgan, J. R., 57, Coldstream-street, Llanelly
1895			Morison, James, Colonial Sugar Co., Ltd., 5, O'Connell-street, Sydney, N.S.W.
1880	Trans.		Moritz, Edward R., Ph.D., 72, Chancery-lane, W.C.
1879	Trans.	C.1887-9 96-1900	‖Morley, H. Forster, M.A., D.Sc., 5, Lyndhurst-road, South Hampstead, N.W.
1895	Trans.		Morrell, R. S., M.A., Ph.D., Gonville and Caius College, Cambridge
1892			Morris, Albert, B.Sc., Fern Bank, Dunkinfield
1900			Morris, E. F., M.A., 69, Shrewsbury-street, Old Trafford, Manchester
1880	Trans.	C. 1896-7	Morris, G. Harris, Ph.D., 72, Chancery-lane, W.C., and 18, Gwendwr-road, West Kensington, W.
1900			Morris, H. N., Gorton Brook Chemical Works, Manchester
1891			Morris, Joseph, Ph.D., 8, Boardman-street, Eccles, Manchester
1891			Morrison, George R., c/o Messrs. E. Ryan and Co., Ltd., Pope's Quay, Cork
1851			Morson, Thomas, 124, Southampton-row, Russell-square, W.C.; and 42, Gordon-square, W.C.
1872			Morton, Edward Handfield, 11, Exeter-road, Brondesbury, N.W.
1893			Morton, Frederick, 101, Quarmby-road, Huddersfield
1890	Trans.		Mosenthal, Henry de, 220, Winchester House, Old Broad-street, E.C.
1896			Moss, Frank A.,
1871			‖Moss, John, 39, Tressillian-road, St. John's, S.E.
1871			‖Moss, Richard J., F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, W. E., 35, Princes-avenue, Liverpool
1896			Mothe, J. T. de la, Grand Bacolet Estate, St. David's, Grenada, W.I.
1886			Moul, Frank, Aldersgate Chemical Works, Southall
1884			‖Moyle, R. E., M.A., Heightley, Chudleigh, Devon
1889			Muir, James, South Haven, Beach-road, Weston-super-Mare
1896			Muir, J. Stanley, B.Sc., The Bella Vista Mining and Milling Co., Miramar, Costa Rica, C.A.
1871	Trans.	C. 1890-4	Muir, M. M. Pattison, M.A., Fellow and Prælector in Chemistry, Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc., The Lodge, Shortlands, Kent
1859	Trans.	C.1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D., F.R.S., 110, Bunhill-row, E.C.; and 13, Park-square East, Regent's Park, N.W.

Date of Election.		
1893	Proc.	Munby, Alan E., Felstead School, Essex
1871		‖Munro, Donald, M.D., C.M., D.P.H., Medico-Legal Department, University of Glasgow
1876	Trans.	Munro, J. M. H., D.Sc., 9, South Parade, Bath
1888		Munroe, Charles E., Prof., Columbia University, Washington, D.C., U.S.A.
1893		Murray, J. Alan, B.Sc., 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894		Murray, John Moore, Municipal Technical School, Arundel-street, Portsmouth
1890	Trans.	‖Murray, Thomas Smith, D.Sc., Chemical Department, The University, Aberdeen
1869		‖Muspratt, E. K., Seaforth-hall, near Liverpool
1873		‖Muspratt, Sidney Knowles, 24, Grove-park, Liverpool
1896		Muter, A. H. M., A.I.C. Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey.
1870	Trans.	‖Muter, John, Ph.D., F.R.S.E., F.I.C., Laboratory, 325, Kennington-road, London, S.E.; and The Châtelet, Horley, Surrey
1890	Trans.	Myers, Harry C., Ph.D., University of California, Berkeley, Cal., U.S.A.
1892	Trans.	Myers, William Shields, M.Sc., Associate Prof. of Chemistry, Rutger's College, 15, Union-street, New Brunswick, N.J., U.S.A.
1887		Nagel, David Henry, M.A., Trinity College, Oxford
1899		Nance, J. T., B.A., Balliol College, Oxford
1874		‖Napier, Arthur S., Prof., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinand strasse, Berlin
1893		Napier, John Watson, Gas Works, Carnoustie, N.B.
1898		Nash, L. M., 281, Seven Sisters-road, Finsbury-park, N.
1900		Naylor, S. B., B.Sc., 73, Castle-street, Bolton
1891		Naylor, William, 16, Walton's-parade, Preston
1878		Naylor, W. A. H., 38, Southwark-street, S.E.
1899		Neale, H. A., Brentwood, Clothorn-road, Didsbury, Manchester
1898		Neilson, A. M., c/o Messrs. Stanes and Co., Coimbatore, Madras, India
1891		Neilson, Thos.
1878	Trans.	‖Nevile, R. H. C., Crown Lea, Malvern
1871	Trans.	Nevill, Edmund Neville, Gov. Lab., Durban, Natal
1890	Trans.	Neville, Francis Henry, F.R.S., Sidney College, Cambridge
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, Balliol College Laboratory, Oxford
1864		‖Newlands, B. E. R., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William, P. R., 27, Glasslyn-road, Crouch End, N.
1889		Newsholme, G. T. Wilkinson, 27, High-street, Sheffield

Date of Election.			
1894	Trans.		Newth, G. S., Royal College of Science, South Kensington
1895			Newton, C. B., Gas Works, Carlisle
1883			Newton, William, Ph.D., F.I.C., 39, Mincing-lane, London, E.C.
1899			Nicholls, W. W. S., 230, Brockley-road, Brockley, S.E.
1870	Trans.		‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., 1, Huskisson-street, Liverpool
1889			Nickels, Wallace Christopher, 54, Dyne-road, Brondesbury, N.W.
1892			Nickolls, J. Bate, The Laboratory, Guernsey
1883	Trans.		Nicol, W. W. J., 15, Blacket-place, Edinburgh
1898			Nightscales, T. A., 9, Tynemouth-street, Hull
1894			Nixon, Alf., Central School, Deansgate, Manchester
1869			Noble, Captain Sir Andrew, K.C.B., F.R.S., Elswick Ordnance Works, Newcastle
1889			Norman, John T., Avalon, Putney Common, S.W.
1861			Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892			Norris, Charles James, Lezayne, Thornton-avenue, Chiswick, W.
1897	Trans.		North, Barker, 3, Manor-terrace, Felixstowe
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, T. H., Prof., Ph.D., University of Cincinnati, Ohio, U.S.A.
1891			Notter, J. Lane, M.A., M.D., West Cliff, Woolston, Southampton
1893	Proc.		Oates, William Henry, Broomhall Park, Sheffield
1890			Oddy, Robert Walter, Waterhouse, Toad-lane, Rochdale
1873			Odling, Walter, Askew-house, Repton; and Messrs. Bass and Co., Burton-on-Trent
1848	Trans.	S. 1856-69 V.P. 1869-72 P. 73-5	Odling, William, M.A., M.B., F.R.S., 15, Norham-gardens, Oxford
1889			O'Mahony, D. J., Municipal-buildings, Anglesea-street, Cork
1890	Trans.		Ormandy, Wm. Reginald, Gamble Institute, St. Helens, Lancs.
1869			‖Orme, Temple A., University College, W.C.; and 213, Uxbridge-road, W.
1872			‖Ormerod, Joseph Arderne, M.D., M.R.C.P., The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887			‖Ormiston, Archibald R., Heathland, Uddingston; and 203, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, Australia
1881			Orr, John Bryson, Blantyre-lodge, Westcombe-park, Blackheath, S.E.
1884	Proc.		Orsman, W. J., jun., Chemical Laboratory, Gathurst, near Wigan

Date of Election.			
1897	Trans.		Orton, K. J. P., M.A., Ph.D., 55, Amsbury-avenue, Streatham-hill, S.W.
1881	Trans.		O'Shea, L. Trant, B.Sc., University College, Sheffield
1887			Ostersetzer, Julius, Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1876	Trans.	C.1882-5 V.P.95-6	†O'Sullivan, C., F.R.S., 148, High-street, Burton-on-Trent
1883	Trans.		O'Sullivan, James, High Bank, Burton-on-Trent
1899			O'Sullivan, John, 742, Nicola-street, Vancouver City, B.C.
1887			‖O'Sullivan, Patrick T., M.B., B.C.L., 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto C. J. G. L., Chantry House, Great Grimsby
1887			Overend, Fred. Lawrence, B.A. (Oxon), Royal Grammar School, Sheffield
1893			Owen, Robert Henry,
1871	Trans.	C. 1889-91	‖Page, Frederick James Montague, B.Sc., 54, Sutherland-street, Pimlico, S.W.
1896			Page, H. M., Headmaster, Govt. College of Science, Poona, Bombay Presidency
1898			Pakes, W. C. C., 14, Trinity-square, S.E.
1884			‖Pallister, J. W., B.Sc., 22, Grimthorpe-terrace, Headingley, Leeds
1882			Palmer, Alfred Neobard, Ingle-nook, Bersham-road, Wrexham
1888			Palmer, Henry John, Summerleaze, Yelverton, R.S.O., Devon
1879			Palmer, Walter, The College, Reading
1899	Trans.		Panting, L.C., B.A., M.B., 9, Beverley-road, Anerley, S.E.
1898			Parker, A. J., 21, East Hill, Dartford, Kent
1897			Parker, C. H., The Copthornes, Copthorne-road, Pennfields, near Wolverhampton
1882			Parker, Joseph R., Avondale, Beaver-road, Ashford, Kent
1894	Trans.		Parker, Matt. A., B.Sc., 13, Hamilton-crescent, Partick, Glasgow
1882			‖Parker, R. H., 35, Clifton-road, Maida Vale, W.
1899			Parkes, G. A., 46, Castle-street, Antrim, Ireland
1890			Parkes, Thomas, M.A., 49, Victoria-crescent, Barnsley
1865	Trans.		‖Parkinson, James, F.G.S., Queen's-chambers, Pirie-street, Adelaide, South Australia
1893			Parrish, S., 10, Sholebrooke-mount, Leeds
1892			Parry, Ernest John, B.Sc., 134, Upper Thames-street, E.C.
1888			Parsons, William, Dispensary, St. Bartholomew's Hospital, E.C.
1870			Patchett, Isaac, F.I.C., 11, Osborne-terrace, Field-hill, Batley
1894	Trans.		Paterson, David, Lea Bank, Rosslyn, Midlothian, N.B.
1885	Trans.		Patterson, George, The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, J. W., 14, Mitchell-street, W. Hartlepool, Durham

† Longstaff Medallist, 1884

Date of Election.			
1895			Patterson, L. G., P.O. Box 76, Ensley, Alabama, U.S.A.
1870	Trans.		Patterson, T. L., Maybank, Finnart-street, Greenock
1863	Trans.	V.P. 1891-4	Pattinson, John, 75, The Side, Newcastle-upon-Tyne
1868	Trans.		||Paul, Dr. B. H., Analytical Laboratory, 20, Victoria-street, Westminster, S.W., and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D., 3, Market-street, Huddersfield
1894			Paulusz, Richard, Assistant City Analyst, Colombo, Ceylon
1896			Payne, Arthur, c/o Messrs Mawson and Swan, Mossley-street Newcastle-on-Tyne
1893			Payne, George F., M.D., Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley J., 48, Grange-road, S.E.
1874			Pearce, William, Chemical Works, Bow Common, E.
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1896	Trans.		Pechmann, H. von, Prof., Tübingen, Germany
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.		||Pedler, Alexander, Prof., F.R.S., Presidency College, and 31/2, Judge's-court-road, Alipore, Calcutta
1886	Proc.		Pendlebury, William Henry, M.A., 6, Gladstone-terrace, Dover
1870			Penney, M. D., 11, High-street, Hull
1895			Pennington, W. H., Field House, Rochdale
1886			Pentecost, Stephen James, Nottingham-road, New Basford, Nottingham
1889	Trans.		Percival, John, M.A., S.E. Agric. Coll., Wye, near Ashford
1884	Trans.		Perkin, A. G., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick M., Ph.D., Borough Polytechnic, Borough-road, S.E.
1856	Trans.	C.1861-2 68-9 S.69-83 P. 83-5	†||Perkin, W. H., LL.D., Ph.D., F.R.S., The Chestnuts, Sudbury, Harrow
1884	Trans.	C. 1891-5	*Perkin, W. H., jun., F.R.S., Fairview, Wilbraham-road, Fallowfield, Manchester
1890	Trans.		||Perman, Edgar Philip, D.Sc., University College, Cardiff
1888			Perry, George Edward, 6, Norwood-villas, Edgbaston, Birmingham
1881			Philip, Arnold, A.R.S.M., B.Sc., Lond., F.I.C., The Merchant Venturers' Technical School, Bristol
1897			Philip, J. C., B.Sc., Ph.D., Royal College of Science, South Kensington, S.W.
1887			Phillips, A, G., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1889			Phillips, Benjamin, 5, Staunton-road, Poona, India
1899			Phillips, E.S., B.A., St. Edmund's School, Canterbury

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† Longstaff Medallist, 1888.
* Longstaff Medallist, 1900.

Date of Election.			
1897			Phillips, H. E. W., B.A., 47, Chalfont-road, Oxford
1882			Phillips, Henry Harcourt, 200, St. George's-road, Bolton
1889			Phillips, Henry Joshua
1897	Trans.		‖Pickard, R. H., D.Sc., Ph.D., Municipal Technical School, Blackburn
1891			Pickering, M. Samuel, B.Sc., Lond., 38, Price-street, Burslem
1878	Trans.	C.1885-7 89-93	‖Pickering, Spencer Percival Umfreville, M.A., F.R.S., 48, Bryanston-square, W., and Harpenden, Herts
1890	Trans.		‖Picton, Harold, B.Sc., Ingleside, Clacton-on-Sea
1894			Pike, E. Brookes,
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D., Sandhills, Salcombe, Kingsbridge, Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, T. W., 33, Grove-hill-road, Denmark-hill, S.E.
1889			Ping, William, Glendale, Selsdon-road, Wanstead, E.
1889			Pingstone, G. Arthur, Bulawayo Public Analyst, P.O. Box 445, Bulawayo, Rhodesia, S.A.
1881			Pisani, O. V., Effingham-house, Arundel-street, Strand, W.C.
1882			Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, F. W., St. Nicholas' Buildings-West, Newcastle-on-Tyne
1899			Pizey, J. H., 11, St. Albans Villas, Highgate-road, N.W.
1893			Platt, Charles, Ph.D., Hahnemann Med. Coll., Philadelphia, U.S.A.
1889			Platts, John Charles, 54, Marlborough-road, Moor Oaks, Sheffield
1860			‖Player, J. H., 16, Prince Arthur-road, Hampstead, N.W.
1899			Polkinghorne, B. C., B.Sc., 46, Lynette-avenue, Clapham-common, S.W.
1888			Pollard, F. Ernest, 18-Bagnall-road, Milton, near Stoke-on-Trent
1898			Pollard, William, B.A., Ph.D., 48, Onslow-road, Richmond, Surrey.
1896			Pollitt, R. B., 2, Woodleigh-villas, Stowmarket
1897			Pollitt, Samuel, B.Sc., Commercial Travellers' School, Pinner
1897			Pollock, W. R., Kirkland, Bonhill, Dumbartonshire
1894	Proc.		‖Pollok, J. Holms, B.Sc., Royal College of Science, Stephen's-green, Dublin
1890			Pond, James Alexander, Auckland, New Zealand
1899			Ponthieu, Georges, Pharmacie Centrale de France, Avenue de Paris, St. Denis (Seine)
1848			Pontifex, Edmund A., M.I.C.E., 72, Cornwall Gardens, S.W.
1862			Pooley, Thomas A., B.Sc., F.I.C., 76, Grove-lane, Denmark-hill, S.E.
1898	Trans.		Pope, T. H., South-street, Ponders End, N.
1891	Trans.	C. 1900	Pope, Wm. Jackson, Goldsmiths' Institute, New Cross, S.E., and 38, Theobald's-road, W.C.
1884	Proc.		‖Porter, T. Cunningham, Rev., Eton College, Windsor

Date of Election.			
1883			Potter, Charles E., c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1896			Potts, H. W., Euroa, Victoria, Australia
1895			Powell, H. James, 530, Lordship-lane, S.E.
1896			Power, F. B., Ph.D., 6, King-street, Snow-hill, E.C.
1884			Power, Francis R., The Royal Mint, Melbourne
1876	Trans.		Prescott, Albert B., Prof., M.D., University, Ann Arbor, Michigan, U.S.A.
1882			‖Price, Arthur F., 524, Sacramento-street, San Francisco
1899			Price, R. C., Prof., Virginia Polytechnic Institute, Blacksburg, Virginia, U.S.A.
1895	Trans.		Priest, Martin, 4, Dane's-inn, Strand, W.C.
1889			Priestley, Charles W., B.Sc., Vivian Institute, Torquay
1870			Pritchard, Prof. William, President Royal Veterinary College, N.W.; and 5, Regent's Park-road, Gloucester-gate, N.W.
1871	Trans.		‖Procter, Henry R., Prof., F.I.C., The Yorkshire College, Leeds, and Thornleigh, Wheatley-road, Ilkley, Yorkshire
1889			Proctor, Charles, Upland House, 359, Upland-road, Dulwich, S.E.
1896			Proude, James, 30, Cromwell-terrace, Halifax
1897			Pullar, H. S., Rosebank, Perth, N.B.
1882			‖Pullar, Rufus D., Brahan, Perth
1892	Trans.		Pullinger, William, B.A., Comstall-road, Romiley, Stockport
1883			Purcell, M. F.,
1875	Trans.	C. 1888-92 V.P. 99	Purdie, Thomas, Prof., Ph.D., B.Sc., F.R.S., University, St. Andrews, N.B.
1886			Pyke, L. S. M., M.I.C.E., 44, Kensington Park-gardens, W.
1868			Quibell, Oliver,
1894			Quinn, Gerald G., Meaford Hall Farm, Meaford, Stone, Staffs.
1894			Quinn, J. Cardwell, c/o Mrs. T. P. Quinn, Olive Vale, Wavertree Nook, Liverpool
1897			Ralston, William, B.Sc., Government Chemist, Lagos, West Africa
1892	Trans.		‖Ramage, Hugh, St. John's College, Cambridge
1888			Ramsay, A. Alexander,
1873	Trans.	C. 1886-8 V.P. 92-5 97-1900	†‖Ramsay, William, Prof. Ph.D., F.R.S., University College, W.C., and 12, Arundel-gardens, Notting-hill, W.
1891			Randall, Percy Morrice, Palmerston-buildings, Old Broad-street, E.C.
1843			Randall, William B., 52, Archers-road, Southampton
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, 12, Bancroft, Hitchin

† Longstaff Medallist, 1897.

Date of Election.			
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1880			‖Rawson, Christopher, The Planter's Club, Mozufferfare, Tirhoot, Bengal, India
1884	Trans.		‖Rawson, Sidney George, D.Sc., Technical College, Huddersfield
1898			Ray, J. Armstedt, jun., B A., 15, Nassau-street, Dublin
1889	Trans.		Read, Arthur A., 3, Fitzalan-place, Cardiff
1895			Read, E. J., B.A., 3, Chester-street, Iffley-road, Oxford
1899	Trans.		Read, H. M., 127, Warwick-road, Earl's Court, S.W.
1890			Redding, Richard James, 29, Isla-road, Plumstead, S.E.
1874	Trans.		‖Reddrop, Joseph, Laboratory, L. and N.W. Ry., Crewe
1892			Redman, Henry Ramsden, 150, Canterbury-road, New Brompton
1866		C. 1891-2	Redwood, Boverton, F.R.S.E., 4, Bishopsgate-street-within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, T. Horne, 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D., Guildhall Chambers, Lloyd-street, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrst-hof, 8, South Park-hill-road, Croydon, S.E.
1893			Rees, George Percival, Eyton House, St. George's, Salop
1880			‖Regester, William, Lawn-lodge. Isleworth, Middlesex
1897			Reid, A. F., Bonshaw, Stewarton, Ayrshire
1898			Reid, J. B.,
1893			Reid, Thomas Anderson, Wincham-house, Lostock, Gralam, Northwich
1881			Reid, Walter Francis, Fieldside, Addlestone, Surrey
1886			Remington, J. Price, Prof.,
1897			Remington, J. S., Meadowside, Lancaster
1879	Trans.		Rennie, Edward H., D.Sc., University of Adelaide, S. Australia
1898	Proc.		Renwick, F. F., St. Kilda, Balfour-road, Ilford, Essex
1873	Trans.	V.P. 1881-3, 89-92, 97-1900	Reynolds, James Emerson, Prof., D.Sc., M.D., F.R.S., Trinity College, Dublin
1857			Reynolds, Richard, 13, Briggate, Leeds
1898	Trans		Reynolds, W. Colebrook, B.Sc., 28, Miskin-road, Dartford, Kent
1891			Rhodes, Edward, Oaklands, Overton, Frodsham, Cheshire
1898	Trans.		Rich, E. M., Frederick-street, Penkhall, Stoke-on-Trent
1889			Richards, Duncan T., 3, Madeira-terrace, Westoc-lane, South Shields
1889			‖Richards, Edgar, 341, West 88th Street, New York, U.S.A.
1889			‖Richards, Percy A. E., F.I.C., 12, Wolverton-gardens, Hammersmith, W.
1886			Richards, William, B.Sc., The Clock House, Tooting, S.W.
1898			Richards, William, 6, Waddington-street, Durham
1885	Trans.		‖Richardson, Arthur, The Central Hindoo College, Benares, N.W.P., India

Date of Election.			
1888	Trans.		‖Richardson, Clifford, Director, New York Testing Laboratory, Long Island City, New York, U.S.A.
1883			Richardson, F. W., Broad Oak, Oak-avenue, Bradford
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert N. B., 10, Friar-lane, Leicester
1866			Richardson, Joseph, 40, Warwick-road, Chorlton-cum-Hardy, Manchester
1892			Richardson, Reginald E. S., Elmfield, Knighton, Leicester
1887	Trans.		Richmond, H. Droop, 24, Baronsfield-road, Twickenham
1845			‖Rickard, W. T., 136, Maygrove-road, West Hampstead, N.W.
1894			Riddick, D. G., Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc., F.I.C., 28, Victoria-street, Westminster, S.W.
1873			Rider, Alonzo John, 4, Haddington-road, Stoke, Devonport
1895			Ridge, W. T. B., 2, Ashwood-terrace, Longton, Staffs.
1882	Trans.		Ridsdale, C. H., Hutton-grange, Guisborough, Yorks.
1888			Rigby, John S., 26, Bagot-street, Wavertree, Liverpool, and West Thurrock, Essex
1898			Rigg, Gilbert, Tudor Villa, Bryn-road, Swansea
1851	Trans	C. 1878-9	Riley, Edward, 14A, Finsbury-square, E.C.
1900			Riley, W. A., Brunswick Lodge, New Market-road, Norwich
1893			Rintoul, William, Royal Gunpowder Factory, Waltham Abbey
1893			Ritchie George, "Hailey," Mount Vernon, N.B.
1893			Robbins, James H., B.Sc., 4, Selborne-road, Ilford
1872			Robbins, John, 57, Warrington-crescent, Maida-vale, W.
1897			Roberts, E. H., 25, Geraldine-road, Wandsworth, S.W.
1883			‖Roberts, Frederick G. Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899			Roberts, James, jun., 43, Great Western-road, Glasgow
1876			Roberts, Martin Fenn, General Post Office, E.C.
1889			Roberts, R. Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894			Roberts, Thos. John, Cowley Villa, 33, Serpentine-road, Liscard, Liverpool
1880			Roberts, W. Brittain, Wilderspool House, Warrington, Lancashire
1866	Trans.	C. 1879-81 V.P. 95-8	Roberts-Austen, Sir William Chandler, K.C.B., F.R.S., Royal Mint, E.
1894			Robertson, A. B., 10, Ethel-terrace, Mount Florida, Glasgow
1887			Robertson, George, London Hospital, E., and Madeira-villa, Woodford Green, Essex
1890	Proc.		‖Robertson, George Henry,
1889			Robins, Harry H., Messrs. Southwell and Co., Dockhead, S.E.

† Longstaff Medallist, 1897.

Date of Election.			
1881			Robinson, G. Carr,
1882	Trans.		||Robinson, Henry H., M.A., 9, The Barons, Twickenham, S.W.
1896			Robinson, H. F., B.Sc., Sparthfield, Droylsden-road, Newton-heath, Manchester
1895			Robinson, H. Lewin, c/o Rev. W. Robinson, Wicken, Soham, Cambridge
1866			Robinson, John, Waveney-mansions, Fairhazel-gardens, Hampstead, N.W.
1892	Trans.		Robson, James, Andersonian-buildings, 204, George-st., Glasgow
1898			Rofe, H. J., B.A., 8, Victoria-street, Westminster, S.W.
1883			Rogers, Arthur W., Tadcaster Tower Brewery Co., Tadcaster
1884			Rogers, Francis M., 21, Burma-road, Stoke Newington, N.
1894			Rolfe, John F., 18, Victor-street, Clayton-le-Moors, Lancashire
1886			Roose, Robson, M.D., 45, Hill-street, Berkeley-square, W.
1855	Trans.	C.1860-3 71-2 V.P.73-4 77-9 P. 80-2	Roscoe, Sir H. E., LL.D., D.C.L., Ph.D., F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8	||Rose, Tom Kirke, D.Sc., 9, Royal Mint, E.
1896			Rosenblum, S. G., F.I.C.,
1896	Trans.		Rosenheim, Otto, Ph.D., 68, Belsize-park-gardens, N.W.
1897			Rosling, Edward, Melbourne, Chelmsford
1894			Ross, Arthur, 1, Glengall-road, Old Kent-road, S.E.
1881			Ross, Rev. Henry, LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, R. St. G., 5, Lavender-road, Worcester
1891	Proc.		Rossiter, Edmund Charles, Bloxcidge House, Langley, Birmingham
1899			Rossiter, Sydney, 19, Ranelagh-road, South Tottenham, N.
1896			Rostron, Harold, B.Sc., 70, Davenport-street, Bolton
1892			Rothewell, C. F. Seymour, 15, Skerton-road, Old Trafford, Manchester
1895			Round, W., 100, Bagot-street, Birmingham
1899			Roundell, C. Foulis, Lieut. Coldstream Guards, Guard's Club, Pall Mall, S.W.
1894			Rowntree, Walter Smithson, B.Sc., F.L.S., Leighton-park, Reading
1862			||Royle, Thomas, 329, Upton-lane, Forest Gate, E.
1872	Trans.		Ruffle, John, Musley, Trinity-road, Ware
1895			Ruggins, W. A., "Strathmore," 14, Empress-avenue, Cranford Park, Ilford
1889	Trans.		Ruheman, Siegfried, Ph.D., M.A., Gonville and Caius College, Cambridge
1883			Rumble, Charles, 20, Patten-road, Wandsworth, S.W.
1890			||Russell, Edward, 35, Southeby-road, Highbury Park, N.
1899	Trans.		Russell, E. J., B.Sc., The Owens College, Manchester

Date of Election.			
1896			Russell, William, c/o The Gold and Silver Extraction Co., Limited, 208-210, McPhee Buildings, Denver, Colorado, U.S.A.
1899			Russell, William, c/o Messrs. Francis and Co., Cliffe Creek, near Rochester.
1851	Trans.	C. 1863-7 70-1 V.P. 72 S. 73-5 T. 75-89 P. 89-91	‖Russell, W. J., Ph.D., F.R.S., 34, Upper Hamilton-terrace, St. John's-wood, N.W.
1897			Rutter, Alfred, School of Mines, Broken-hill, N.S.W.
1896			Rutter, T. F., B.Sc., The Municipal Technical School, Birmingham
1894			Ryce, George, B.A., County Education Offices, 50, Queen-street, Exeter
1888			Sach, A. J., Technical School, Goulburn, N.S.W.
1868			Sadler, S. A., Cleveland Chemical Works, Middlesbrough
1882			Sadtler, Samuel P., Ph.D., 145, North 10th-street, and 1042, Drexel-buildings, Philadelphia, U.S.A.
1896			Sage, C. E., 40, Lambs Conduit-street, Bloomsbury, W.C.
1898			St. John, Harry, Thornfield, Sunderland
1879	Trans.		‖Sakurai, J., Science College, Imperial University, Tokyo, Japan
1880			Salamon, Alfred Gordon, 27, Holland-park, W.
1876			‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and Berkeley Chambers, 13, Bruton-street, Hyde-park, W.
1896			Salt, A. P., Sunnyside, Pinner-road, Harrow
1863			‖Salt, Henry, M.D., C.M., F.R.G.S., Inglewood, Great Malvern
1871			‖Salter, Mortyn John, Northcote, 51, Beaconsfield-road, New Southgate
1859			‖Salter, Thomas W., 15, Belle Vue, West-hill, Hastings
1882			Samuel, W. Cobden, Wilton Lodge, 337, Norwood-road, West Norwood, S.E.
1898			Sand, H. J. S., Ph.D., 3, Warwick-place, Frances-road, Birmingham
1870			‖Sandberg, C. P., Palace-chambers, 9, Bridge-street, Westminster, S.W.
189			Sandercock, Thos. J. Buckler, Sidcup College, Sidcup, Kent
1900			Sanders, J. McConnell, 8, Highfield-road, Dartford
1888			Sanderson, John, 4, Lancaster-road, Belsize-park, N.W.
1882			Sanford, P. Gerald, Laboratory, 20, Cullum-street, E.C.
1890			Saniter, Ernest Henry, 51, Grange-road, West Middlesbrough
1891			Sanyal, Abhayacharan, M.A., Professor of Physical Science, Queen's College, Benares, N.W.P., India
1892			Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900			Sargeant, F. Pilkington, Springfield-place, Leeds

Date of Election.			
1886			Saunders, Prof. William, Experimental Farm, Ottawa, Ontario, Canada
1896			Saville, A. E., Gas Works, Holyhead
1898			Sayer, H. C., 8, Highfield-road, Dartford
1890			Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885			Scammell, Luther R., 42-4, King William-street, Adelaide, South Australia
1877			Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897			Scargill, L. W. K., B.A., 4, Lingdale-road, Birkenhead.
1893	Trans.		Schidrowitz, Philip, Ph.D., 57, Chancery-lane, W.C.
1888			‖Schieffelin, William Jay, Ph.D., 840, Southern-boul., New York, U.S.A.
1892	Trans.		Schloesser, Augustus, Ph.D., Storey Institute, Lancaster
1892			‖Schofield, James Alexander, University of Sydney, New South Wales
1899	Trans.		Schryver, S. B., D.Sc., Ph.D., 27, Arundel-gardens, W.
1842	Trans.	C 1847-9, 59-62 V.P. 82-85	Schunck, Edward, Ph.D., F.R.S., Oaklands, Kersal, Manchester
1899			Schweich, M. E., 85, Belgrave-road, S.W.
1896			Scotland, P. B., Airdrie Academy, Airdrie, N.B.
1879	Trans.	C. 1897-9 S. 1899-1900	‖Scott, Alexander, M.A., D.Sc., F.R.S., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1887			Scrutton, W., 18, Billiter-street, E.C.
1883	Proc.		Scudder, Frank, 44, Mosley-street, Manchester
1896			Seabrooke, H. C., Laboratory, The Brewery, Reading,
1891			Searl, Albert, Montreux, Victoria-road, Sidcup
1890			Seaton, Edward [illegible], M.D., The Limes, 56, North Side, Clapham Common, S.W.
1899			Seligman, Richard, 15, Queen's Gate-gardens, S.W.
1892	Trans.		Sell, William James, M.A., Univ. Chem. Laboratory, Pembroke-street, Cambridge
1875			Sellon, J. Scudamore, 78, Hatton-garden, E.C.
1875	Trans.		‖Senier, Alfred, Prof., M.D., Ph.D., Queen's College, and Gurthard, Galway
1899			Senier, George, B.A., Brynaneron, St. George's-road, Abergele, North Wales
1887			Senier, Harold, Braybrook Lodge, Harrow
1893			Sessions, Wilfred, B.Sc., Dalton House, Kendal
1896			Severn, W. D.,
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.

Date of Election.			
1874			‖Sexton, A. Humboldt, F.I.C., F.R.S.E., Professor of Metallurgy, Metallurgical Department, Andersonian-buildings, 204, George-street, Glasgow
1895			Seyler, C. A., B.Sc., 31, Windsor-terrace, Swansea
1880			Shadwell, J. E. L., Gable End, Mill-road, West Worthing
1873			Shapleigh, Waldron, Welsbach Incandescent Gas Light Co., Factory, Gloucester City, New Jersey, U.S.A.
1893			‖Shapley, Frederick, c/o Messrs. L. Bergen and Sons, 248, Front-street, New York
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, The Towers, Low Moor, near Bradford
1895			Sharrott, T. C., Chestnut House, Tamworth
1892			Shaw, G. Arthur, 45, St. Petersgate, Stockport
1895	Trans.		Shaw, G. E., 9, Basing-road, Westbourne-park, W.
1890	Trans.		Shaw, Saville, M.Sc., Durham College of Science, Newcastle-upon-Tyne
1887			Sheard, John T., Birley Mount-villas, Wadsley-bridge, near Sheffield
1889			Shegog, Thomas Alexander, Fernside, Clytha Park, Newport, Mon.
1899			Shelbourn, E. T., F.I.C., 40, Craven-street, Strand, W.C.
1899			Shelton, A. J., c/o The Schultze Gunpowder Co., Ltd., Eyeworth Lodge, Farnworth, Hants
1876	Trans.	C. 1893-7	‖Shenstone, W. A., F.R.S., Clifton College, Bristol; and Glenfarg Villa, Percival-road, Clifton, Bristol
1897			Shenton, J. P., 34, Lansdowne-road, West Didsbury, Manchester
1899	Trans.		Shepheard, W. F. J., 12, Bridge-street-row, Chester
1874			‖Shepherd, H. H. B., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899			Shepherd, J. W., B.Sc., 48, Ovington-street, S.W.
1898			Sheridan, M. J., 20, Heathland-road, Stoke Newington, N.
1891	Trans.		‖Shields, John, Ph.D., D.Sc., Tower Bank, Leven, Fife, N.B.
1896			Shimomura, Kotaro, Prof., c/o Sekijen Ginko, 61, Imabashi Shichome, Osaka, Japan
1894			Shorthouse, H. S., 47, Pershore-road, Birmingham
1886			Shutt, Frank T., M.A., Experimental Farm, Ottawa, Canada
1890			Shuttlewood, W. Brewin, 8, Clifton-road, Crouch End, N.
1894			Shuttleworth, E. B., Prof., 220, Sherborne-street, Toronto, Canada
1859			Sibson, Alfred, 23, St. Mary Axe, E.C.
1889			Sibson, Alfred Edward, 1, Maple-villas, Palmerston-road Buckhurst Hill, Essex
1874	Trans.		Siebold, Louis, Broomville-avenue, Sale, near Manchester
1886			Silvester, Harry, 78, Holyhead-road, Handsworth, Birmingham
1885			Sim, James, 6, Carden-terrace, Aberdeen

Date of Election.			
1899			Simmonds, Charles, B.S., Belle Vue, Thurlow Hill, West Dulwich, S.E.
1889			Simmonds, Henry, Engineer's Office, Gas Works, and Elton View House, Bury, Lancashire
1887			||Simmons, L. Owen, 360, Coldharbour-lane, Brixton, S.W.
1895			Simons, A. J., c/o M. Simons, Esq., 31, Little Britain, E.C.
1896			Simpson, A. M., Elmcroft, 34, Erlanger-road, New Cross, S.E.
1897			Simpson, E. S., B.E., Geological Survey Office, 395, St. George's-terrace, Perth, W.A.
1857	Trans.	G.1864-7 69-70 V.P.72-4	Simpson, Maxwell, M.D., F.R.S., 9, Barton-street, West Kensington, W.
1886			||Simpson, William Selby, Halcyon House, Private-road, Enfield, N.
1889			Singer, Ignatius, G.P.O., Wellington, N.Z.
1896			||Siroar, Amrita Lal, 51, Sankaritola, Calcutta
1888	Trans.		Skinner, Sidney, M.A., The Cavendish Laboratory, Cambridge
1899	Trans.		Skirrow, F. W., Rose Bank, Bentham, Lancaster
1892			Skurray, Thomas, United Breweries, Abingdon, Berkshire
1879			Slater, Charles, M.A., M.B., M.R.C.S., 81, St. Ermin's-mansions, Westminster
1880	Trans.		||Slater, Harold H., Havelock-villa, St. James's-road, Gravesend
1878			||Slatter, George W., F.I.C., Carlton-terrace, Nab Wood, Shipley, Yorkshire
1895			Slocum, F. L., Linden-avenue Corner, Reynolds-street, Pittsburg, Pa., U.S.A.
1863	Trans.		Smee, A. Hutchinson, The Grange, Hackledge, Carshalton, Surrey
1875			||Smetham, Alfred, Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1898	Trans.		Smiles, Samuel, B.Sc., Fairoak, Overbury-avenue, Beckenham
1883			Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.		||Smith, Alexander, Ph.D., B.Sc., University of Chicago, Chicago, U.S.A.
1888			Smith, Angus, 10, Ardgowan-street, W., Greenock, N.B.
1898			Smith, B. Jordan, 42, King's-road, Reading, and 1, Leyton-avenue, Mansfield, Notts.
1894	Trans.		Smith, Claude, 2, Castle Hill-terrace, Lancaster, W.
1884			||Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1894	Trans.		Smith, Ernest A., Assay Office, Leopold-street, Sheffield.
1900			Smith, E. Shrapnell, 35, Botanic-road, Wavertree Park, Liverpool
1892			||Smith, Fred., P.O. Box 1324, Johannesburg, S.A.R.
1874			Smith, George, Nobel's Explosives Co., Polmont Station, Scotland
1883			Smith, George, 282, Friern-road, East Dulwich, S.E.

Date of Election.			
1896			Smith, G. E. Scott, 67, Surrey-street, Sheffield
1892			‖Smith, George P. Darnell, The Merchant Venturers' Technical College, Bristol
1896	Trans.		Smith, H. G., The Technological Museum, Sydney, N.S.W.
1878			Smith, H. R., 1, Aubert-park, Highbury, N.
1890			Smith, Harry Wood, B.Sc., The British Cyanides Co., Ltd., Oldbury, Birmingham
1900			Smith, J. Hart, A.I.C., 4, Edenvale-street, Fulham, S.W.
1892			Smith, John Meadows, Laboratory, 66, College-street, Chelsea, S.W.
1879			Smith, J. W., Massachusetts Institute of Technology, Boston, Mass., U.S.A.
1897			Smith, R. F. Wood, 89, Bartholomew Close, E.C.
1891			Smith, R. Greig, M.Sc., Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1888			Smith, Sam, Hillsboro', Goddard-avenue, Old Swindon
1886			Smith, Sidney,
1898			Smith, T. de, B.A., 152, Evering-road, Stoke Newington, N.
1876			Smith, W. A., M.A., M.B. Oxon, M.R.C.S. Eng., Newport, Essex
1866	Trans.		Smith, Watson, 34, Upper Park-road, Haverstock Hill, N.W.
1883	Trans.	{ C. 1896-190 }	Smithells, Arthur, Prof. B.Sc., The Yorkshire College, Leeds
1873			‖Smyth, John, M.A., Milltown, Bantridge, Ireland
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc., Ph.D., Chemical Laboratories, University College of Wales, and De Wyneb, Caradoc-road, Aberystwyth
1899			Soddy, Frederick, 36, Wellington-square, Oxford.
1896	Trans.		Sodeau, W. H., B.Sc., University College, Cardiff.
1887			Sohn, Charles E., F.I.C., 22, Southampton-row, W.C.
1891			Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1898			Somerville, Henry, B.Sc., 33, Vincent-square, S.W.
1874	Trans.		Sonstadt, Edward, Church Field, Cheshunt, Herts
1893			Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875			Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897			Southerden, Frank, 75, Barry-road, Dulwich, S.E.
1897			Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1883			Soward, Alfred W., 28, Therapia-road, Honor Oak, S.E.
1892			Spackman, Charles, Rosehaugh, Clitheroe, Lancashire
1889			Speakman, James,
1883			‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1878			Spencer, James, B.Sc., 38, Ash-grove, Bradford
1886			Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887			Spencer, W. Shelley, Lyndene, Darley, Farnworth, near Bolton

Date of Election			
1894			Spenzer, John George, Prof., M.D., Ph.D., Ohio Wesleyan University, 253, Amesbury-avenue, Cleveland, Ohio, U.S.A.
1859	Trans.		||Spiller, John, 2, St. Mary's-road, Canonbury, N.
1863			||Spiller, William, Atlas Dye Works, Hackney-wick, E.
1885			Spilsbury, James, Mayfield, Mayfield-road, Moseley, Birmingham
1898	Trans.		Spivey, W. T. N., M.A., 5, Trumpington-street, Cambridge
1885			||Spottiswoode, W. Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1892			Spray, Henry John, 29, Windsor-road, Ilford-lane, Ilford, Essex
1864	Trans.	C. 1872-5	Sprengel, Hermann Johann Philipp, Ph.D. (Heidelb.) F.R.S., Royal Prussian Professor (titular), Savile Club, 107, Piccadilly, W.
1895			Squance, T. C., M.D., M.S., L.S.Sc., F.R.M.S., F.R.M.St. S., 15, Grange-crescent, Sunderland
1882			||Squire, P. Wyatt, 413, Oxford-street, W.
1858	Trans.		Squire, W. Stevens, Ph.D., Clarendon House, St. John's Wood-park, N.W.
1892			Squires, Alfred James, 88, Derby-road, Farnworth, Widnes, Lancs.
1877			Stacey, Henry George, 300, High Holborn, W.C.
1897			Stainer, W. J., B.A., Charlesville, Beaconsfield-road, Widnes, Lancs.
1899			Stainer, W. J., 103, Cheriton-road, Folkstone
1879	Trans.		||Stallard, George, M.A., Horton-crescent, Rugby
1887			Stanger, W. Harry, Chemical Laboratory, Broadway, Westminster
1887			||Stansell, Lionell W., 7, Albion-place, Maidstone, Kent
1895			||Stansfield, Alfred, D.Sc., Royal College of Science, South Kensington, S.W.
1899			Stansfield, Samuel, B.Sc., White Sea, Mytholmroyd, Manchester
1870			Starey, Arthur J., Blythwood, Muswell-avenue, Muswell-hill, N.
1870	Trans.		||Stark, J. Fleming, 9, Allfarthing-lane, Wandsworth, S.W.
1896			Stead, J. C., Mitre Chemical Works, Cordova-road, Bow, E.
1882	Trans.		Stead, J. E., 11, Queen's-terrace, Middlesbrough
1882			Stebbins, James H., jun., Ph.D., 80, Madison-avenue, New York, U.S.A.
1897			Steel, F. W., c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Victoria
1885			Steel, Robert Elliot, County School, Northampton
1894			Steel, Robert W., St. Ninians, Meiklerigg, Paisley
1889			Steel, Sydney, 17, Gt. Tower-street, E.C.
1890			Steel, Thomas, c/o Colonial Sugar Refining Co., Sydney, N.S.W.
1884			Steele, Robert, The Bowers, Wandsworth Common, S.W.
1898			Steinhart, O. J., Ph.D., Blackfriars Testing Works, 91, Blackfriars-road, S.E.
1892	Trans.		||Stenhouse, James, View Park Gardens, Bonnyrigg, Midlothian, N.B.

Date of Election.			
1884			Stenhouse, Thomas, Townhead, Rochdale
1895	Trans.		Stephens, F. R., c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880			‖Stephens, Henry Charles, M.P., Cholderton, Salisbury
1897			Stephens, M. E., Avenue House, Finchley, N.
1895			Stephenson, Herbert F., 14, Gap Road, Wimbledon, S.W.
1885			Stephenson, Stephen, 98, Kensington, Liverpool
1891	Trans.		Stephenson, Thomas, Oriental Buildings, Fort, Bombay
1888	Trans.		Stern, Arthur Landauer, D.Sc., F.I.C., 170, Ashby-road, Burton-on-Trent
1898			Steuart, Basil, Parkisimo P.O., Manitoba, Canada
1881			Steuart, Daniel Rankin, Osborne Cottage, Broxburn, Linlithgowshire
1896			Steuart, D. Stuart Spens, B.Sc., The Royal Societies' Club, St. James's-street, S.W.
1897	Trans.		Stevens, H. P., B.A., The Firs, Guildford-road, Ash, Surrey
1899			Stevenson, Arnold, B.A., 4, Porchester-gardens, W.
1864		C.1872-4 86-7,94-7 V.P. 1900	Stevenson, Thomas, M.D., Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, W. F. K., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcestershire
1887			Stocks, Herbert B., 6, Sydney-road, Churchtown, Southport
1894			Stoddart, Frederick Wallis, Grafton Lodge, Sneyd Park, Bristol
1879	Trans.		‖Stokes, A. W., Vestry Hall, Paddington, W.
1873			‖Stone, Edward Daniel, Rose Lea, Alderley Edge, Cheshire
1890			Stone, Frederick Richard M., 58, Upper Parliament-street, Liverpool
1895			Stone, George, McCracken's City Brewery, Melbourne
1875			‖Stone, J. Harris, M.A., F.L.S., Barrister-at-Law, 4, Temple, E.C.
1879			‖Stone, William, M.A. (Cantab), F.L.S., Oxford and Cambridge, Garrick, and Union Clubs, and D 6, The Albany, Piccadilly, W.
1891			‖Storey, James Ashburner, B.Sc., Igalkanda Estate, Elpitiya, Ceylon ; and Underfell, Lancaster
1884			Stormouth, Thomas,
1900			Storr, B. V., B.Sc., 203, Grange-road, Ilford, Essex
1887			‖Strangman, J. Pim, 38, Rue Desbordes-Valmore, Paris-Passy
1900			Strong, A. H., 63, Herne-hill-road, Camberwell, S.E.
1885	Trans.		‖Stuart, Charles M., M.A., St. Dunstan's College, Catford, S.E.
1897			Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1893			Styles, R. Curling, Knockhall, Greenhithe, Kent

Date of Election.		
1890	Trans.	‖Sudborough, J. Joseph, Ph.D., D.Sc. University College, Nottingham
1878	Trans.	‖Suguira, Shigetake, c/o Tokio Chemical Society, 50, Kasugacho, Koishikawa, Tokio, Japan
1897		Sumner, Leonard, B.Sc., Butt Hill, Prestwich, near Manchester
1887		‖Sutherland, D. A., F.I.C., 13, Victoria-street, Westminster, S.W.
1884		Sutton, C. W., 19, Henley-road, Ipswich
1860		Sutton, Francis, Laboratory, Bank Plain, Norwich
1886		‖Sutton, F. Napier, 6, Grosvenor-gardens, Willesden Green, N.W.
1875		Swan, Joseph Wilson, M.A., F.R.S., 58, Holland-park, W.
1889		Swan, Robert M. W., 15, Walmer-crescent, Glasgow
1894		‖Swinburne, James, 82, Victoria-street, S.W.
1891		Sykes, M. Carrington, L.P.H. Lond., L.R.C.P. Lond., M.R.C.S. Eng., L.S.A. Lond., Sykeshurst, Barnsley, Yorks.
1891		Symes, K. Edward, 95, Lodge-road, The Avenue, Southampton
1880		Symons, Brenton, 5, Kew Gardens-road, S.W
1874	Trans.	‖Symons, William H., M.D. (Brux.), D.P.H. (Oxon.), M.R.C.S. Eng., F.I.C., Medical Officer of Health's Dept., Guildhall, Bath
1899	Trans.	Szarvasy, E. C., Ph.D., Muegyetem VIII, Budapest, Hungary
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokio, Japan
1887	Trans.	Takamine, Jokichi, 90, Maiden-lane, New York, U.S.A.
1894		Tanner, Alf. E., Westminster Hospital, S.W.
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D., 11 and 12, London and Lancashire Chambers, 45A, Dale-street, Liverpool
1884		‖Tate, Walter, The Woodlands, Twerton-on-Avon, Bath
1890		Tate, William, Prof., Civil Engineering College, Sibpur, Calcutta
1867		Tatlock, Robert R., Novara, Stirling
1897		Taverner, William, 1, Stapenhill-road, Burton-on-Trent
1894		Taylor, Albert,
1882		Taylor, G. Midgley, 27, Great George-street, Westminster, S.W.
1894		Taylor, Herbert J., 9, Portland-villas, Bath-street, Dewsbury
1880		‖Taylor, James, B.Sc., Government Metallurgical Works, Clyde, New South Wales
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John G., 16, Trinity-street, Stockton-on-Tees
1874	Trans.	Taylor, R. L., 37, Mayfield-road, Whalley Range, Manchester
1888		Taylor, William, China Sugar Refining Co., East Point, Hong Kong
1878		‖Tcherniac, Joseph, Ph.D., Thalstrasse 1, Freiburg, Briesgau, Germany
1879	Trans.	‖Teed, Frank L., D.Sc., 9, Mincing-lane, E.C.
1877		Terrill, William, 42, St. George's-terrace, Swansea

Date of Election.			
1894			‖Terry, Edwin, 374, Brixton-road, S.W.
1881			Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893			Thackrah, James R., M.A., Ph.D., Technical Schools, Tavistock-road, Plymouth
1895			Theodosius, A. F., B.A., University College, Oxford
1896			Thiersch, H. A., 36, Clifton-gardens, Maida Vale, W.
1859			‖Thomas, Andrew, c/o M. C. Neville, Esq., 9, Hendley-street, Adelaide, South Australia
1871			‖Thomas, Charles, J.P., Stoke Bishop, nr. Bristol
1874			Thomas, Harry E., Rockleaze Point, Clifton, Bristol
1875	Trans.		‖Thomas, Joseph William, 2, Hampstead Hill Mansions, N.W.
1863			‖Thompson, Beeby, 67, Victoria-road, Northampton
1896			Thompson, Charles, B.Sc., The Furlands, Coatham, Redcar
1886	Trans.		‖Thompson, Claude M., Prof., D.Sc., M.A., University College, and 38, Park-place, Cardiff
1894			Thompson, Edward Cumming, 48, Kestrel-avenue, Herne Hill, S.E.
1893			Thompson, Frank Ernest, 51, Lichfield-road, Walsall
1893			Thompson, George R., The Laboratory, 57, Dock-street, Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1886			Thompson, W. Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1885	Trans.		Thomson, Andrew, D.Sc., Ardenlea, Pitcullen, Perth
1876			Thomson, George C., 4, The Green, Bromborough Pool, near Birkenhead
1858	Trans.		‖Thomson, John, Gwydor-villa, Elmers End, Beckenham
1872	Trans.	C.1880-2 S 83-98 V.P. 1898.	‖Thomson, John Millar, Prof., LL.D., F.R.S., King's College W.C.; and 85, Addison-road, Kensington, W.
1899			Thomson, R. T., 156, Bath-street, Glasgow
1872			Thomson, William, Royal Institution Laboratory, Manchester
1895			Thomson, W. T., Oxford-villas, Waltham Abbey
1891			Thonger, C. G. Freer, M.R.A.C., Colonial College, Hollesley Bay, Suffolk
1882	Trans.		Thorne, Leonard T., Ph.D., 8, Dynevor-road, Richmond
1890			Thornley, J. Brooks, jun.,
1895			Thornton, Arthur, M.A., The Grammar School, Bridlington
1891			Thorp, Walter, B.Sc., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph.D., Owens College, Manchester
1871	Trans.	C.1879-82 V.P. 84-6 T. 89-99 P. 1899.	‖†Thorpe, T. E., Ph.D. (Heid.), B.Sc. (Vict.), D.Sc. (Dubl.), LL.D. (Glas.), F.R.S., Government Laboratory, Clements Inn-passage, W.C.

† Longstaff Medallist, 1881.

Date of Election.			
1899			Threlfall, Richard, Prof, F.R.S., 259, Hagley-road, Edgbaston, Birmingham
1894			Thudichum, George Dupré, 2, Salcombe-villas, Kingston-road, Merton Park, Wimbledon
1860	Trans.	C. 1879-80	Thudichum, John L. W., M.D., 11, Pembroke-gardens, W.
1880			Thwaite, B. H., 29, Great George-street, Westminster, S.W.
1895			Tibbals, W. I., 93, Cass-street, Detroit, Mich., U.S.A.
1863	Trans.		Tichborne, C. R. C., Ph.D., 15, North Great George-street, Dublin
1897	Trans.		Tickle, Thomas, Herbert-villa, East-lane, Wembley, Middlesex
1865	Trans.	C. 1878-80 V.P. 85-7 91-4, 96-9 T. 1899-	||Tilden, William A. Prof., D.Sc. (Lond.), D.Sc. (Dubl.), F.R.S. Royal College of Science, South Kensington ; and 9, Ladbroke-gardens, W.
1889	Trans.		||Tingle J. Bishop, Ph.D., Lewis Institute, Chicago, Ill., U.S.A.
1891			Tocher, James Fowler, A.I.C., 1, Chapel-street, Peterhead
1884	Trans.		||Tompson, Frederick William, Crockham Hill, Edenbridge
1877			||Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1855	Trans.		||Tookey, Charles, Museum of Practical Geology, Jermyn-street, S.W., and The Portland Hotel, Great Portland-street, W.
1893			||Towers, John William, Victoria-road, Widnes
1888			Townsend, Charles F., West View, Swanley-junction, Kent.
1887			||Traphagen, Dr. Frank W., Agricultural Experiment Station, Bozeman, Montana, U.S.A.
1892	Trans.		Travers, Morris W., D.Sc., 2, Phillimore-gardens, Kensington, W.
1895			Treharne, F. G., Wrangbrook, Llanishen, near Cardiff
1894			Trench, George, c/o Tupper's Library, Herne Bay, Kent
1888			||Trewby, Herbert, 62, St. John Street, E.C.
1881			Trigger, Oliver, Chemical Dept., Royal Arsenal, Woolwich, S.E.
1897			Tripp, E. H., Ph.D., The Grammar School, Swansea
1873			||Truman, Edgar, M.D.,
1898			Tucker, S. A., Ph.D., Columbia University, New York, U.S.A.
1889			Tucker, Willis G., M.D., Medical College, Albany, New York, U.S.A.
1896			Tuckett, J. E. S., M.A., Cantab, Eastbourne College, Eastbourne
1892			Tuer, Arthur Holt, Thornhill, Wigan, Lancashire
1897	Trans.		Turnbull, Andrew, Ph.D., The Yorkshire College, Leeds
1886			Turner, Arthur, L.D.S.Ed., The Limes, Aylesbury
1896			Turner, B. B., B.Sc., South Eastern Hospital, New Cross-road, S.E.
1897			Turner, B. W., c/o H. Turner, Esq., Collins Street, Annandale Sydney, N.S.W.
1888	Trans.		Turner, Charles, 225A, Oxford-street Manchester
1897			Turner, J. S., 20, Bury-street, Bloomsbury, W.C.
1883			||Turner, Thomas, A.R.S.M., F.I.C., Ravenhurst, Rowley Park, Stafford

Date of Election.			
1889	Trans.		Turpin, George Sherbrooke, M.A. (Cantab), D.Sc. (Lond.), Schoolhouse, Swansea
1892			Turton, Albert H. F.R.S.Ed., F.G.S., c/o The Inst. of Mining and Metallurgy, Broad-street House, Broad-street, E.C.
1871			‖Tustin, John Robt., F.R.G.S., Albion House, The Marina, Deal
1888	Trans.		Tutton, Alfred E., F.R.S., 17, Bardwell-road, Oxford
1879			Tweedie, G. R., Leighton House, Marlow, Bucks.
1892			Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1899			Tyler, E. A., B.A., Warsop, Mansfield
1876			Typke, P. G. W., Lawn House, New Malden, Surrey
1876			Tyrer, Thomas, Stirling Chemical Works, Abbey-lane, Stratford, E.
1885			Tyson, Thomas B., Glendalough, Howth-road, Dublin
1876			‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffordshire
1865			Umney, Charles, 50, Southwark-street, S.E.
1893	Trans.		Umney, John C., 50, Southwark-street, London, S.E.
1889			Underhill, Thomas J., 6, The Terrace, Royal Victoria Yard, Deptford, S.E.
1897			‖Unwalla, R. N., Medical Dept., Bhaunagar, Kathiawâr, India
1882			‖Vacher, Francis,
1890			Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1883			Vasey, S. A., Kingsthorpe, Lower Park, Loughton, Essex
1882			Vasey, Thomas E., P.O. Box 1149, Montreal, Canada
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor H., M.A., F.R.S., 20, Bradmore-road, and University Museum, Oxford
1891			Velling, F. W. De, B.A., High Grade Board School, The Boulevard, Hull
1881			Venable, Frank P., Ph.D., Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas J. M., Apartado No. 237, Bogotá, Columbia
1897			Viccajee, F. K., H.H. The Nizam's Mint, Hyderabad, Deccan, India
1872			Vincent, Charles W., F.R.S.E., F.C.S. of Berlin, Reform Club, Pall Mall, S.W., and Royal Institution, W.
1897			Vinter, P. J., M.A., 33, Lynton-road, Acton, W.
1884		C. 1891-5	‖Voelcker, Edward William, 22, Tudor-street, Blackfriars, E.C.
1884			‖Voelcker, John A., Ph.D., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖Voss, Walter Arthur, 15, Nicholson-road, Addiscombe, Croydon
1885			Vulté, Hermann T., Ph.D., Barnard College, 119 St., and Boulevard, New York
1898			Wade, A. L., 28, West Kensington-gardens, W.

Date of Election.			
1890	Trans.		Wade, John, B.Sc. (Lond.), Wyvenhoe, Purley, and Guy's Hospital, S.E.
1894			‖Wagner, W. G., Glyndhurst, Ealing Common, W.
1884			Wainwright, J. Howard, Ph.D., 159, Front-street, New York City, U.S.A.
1893			Wait, Chas. E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			Wait, Frank Goodell, Geological Survey Department, Ottawa Canada
1897			Waite, W. H., M.A., Park-road, Halifax
1899			Walden, A. F., M.A., New College, Oxford
1897			Walford, S. M., Oak-street, Woodley, Stockport
1893			Walke, Willoughby, Major, 3rd Regt. U.S. Engineers, Fort Monroe, Virginia, U.S.A.
1868			‖Walker, Maj.-Gen. Alexander, C.S.I., R.A.,
1881			‖Walker, Archibald, B.A., 8, Crown-terrace, Dowanhill, Glasgow
1898			Walker, A. Jamieson, B.A., Ph.D., The Borough Polytechnic Institute, Borough-road, S.E.
1898			Walker, Charles, c/o T. B. Walker, Esq., Scott-chambers, Pitt-street, Sydney, N.S.W.
1894	Trans.		Walker, Chas. H. H., M.A., 16, Worcester-place, Oxford
1890	Trans	C. 1899-	‖Walker, James, Prof., D.Sc., 19, Springfield, Dundee
1865	Trans.		‖Walker, J. F., M.A., 45, Bootham, York; and Sidney Sussex College, Cambridge
1890			Walker, James S. H., M.B., C.M., 56, Queen's-road, Aberdeen
1888			Walker, J. T. Ainslie,
1897	Trans.		Walker, J. Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1881			Walker, Robert William, Wicken Hall, New Hey, near Rochdale
1898			Walker, Samuel, M.A., B.Sc., 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1896			Walker, W. H., Stafford-street, Willenhall, Staffs.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, Ph.D., 7, Franklin-place, Morristown, N.J., U.S.A.
1898			Waller, H. F., School of Mines, Zeehan, Tasmania
1887			Wallis, Henry Weston, 11, Probyn-road, Tulse Hill, S.W.
1883			‖Walmsley, R. Mullineux, D.Sc., Northampton Institute, St. John Street-road, Clerkenwell, E.C., and 23, Hilldrop-road, Camden Town, N.W.
1888			Walrond, Edward Dalrymple, B.A., North Eastern Counties, School, Barnard Castle, Durham
1898			Walton, Ambrose, Globe Chemical Works, Marple, Cheshire

Date of Election.			
1896			Walton, R. H., Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884			‖Walton, Thomas Ulrick, B.Sc., F.I.C., Colonial Sugar Refinery Co., Sydney, New South Wales
1864			Ward, George, Buckingham-terrace, Headingley, Leeds
1895			Ward, G. J., Hallam Fields, Ilkeston
1891			Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1871			Ward, William, 8, Kenwood-park-road, Sheffield
1873			Warden, C. J. H., Lt.-Col., I.M.S., 26, Highbury-grove, N.
1875			Wardle, Sir Thomas, F.G.S., Leek, Staffordshire
1863	Trans.	C. 1874-5 78-81 V.P. 89-93	‖Warington, Robert, F.R.S., High Bank, Harpenden, St. Albans
1893			Warmington, Edward A., Ph.D., F.I.C.,
1871			Warner, George Joseph, Halton Villa, Widnes
1894			Warren, W. L., 12, Westland-row, Dublin
1888			Warrick, Frederic Walmsley, 7, Portpool-lane, E.C.
1887	Trans.		Warrington, Arthur Walley, M.Sc., The Gamble Institute, St. Helen's, Lancs.
1895			Warrington, T. C., 52, Regent's-road, Hanley, Staffs.
1895			Warwick, A. W.,
1882			Waterfall, Charles J., 4, Queen-square, Bristol
1894			Waterfield, A. Swainson, Grammar School, Bromyard, Worcester
1894			Waterhouse, Robert, c/o Messrs. J. Fisher and Sons, Limited, Queen's-street, Bradford, Manchester
1889			Waterhouse, Wm. John, B.Sc., Christchurch, Oxford
1888			Wates, Edward Arthur, 56, Breakspears-road, Brockley, S.E.
1893			Watson, A. Forbes, 22, Trafalgar-terrace, Monktown, co. Dublin
1885			Watson, Charles, c/o The English Literary Society, San Martin 243, Buenos Ayres, Argentine Republic
1899			Watson, F. S., B.Sc., Beech-house, New Mills, Stockport
1887			‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1883			‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1896	Trans.		Watson, Wm., Rev., M.A., School House, Kingsbridge, S. Devon
1876			‖Watson, W. H., J.P., Steelfield-hall, Gosforth, Cumberland
1877			Watt, Alexander, c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1897			Watts, C. T. F., B.Sc., 33, Saughall-road, Chester
1883	Trans.		Watts, Francis, Government Laboratory for the Leeward Islands, Antigua, W.I.
1872	Trans.		‖Watts, John, D.Sc., Merton College, Oxford
1878	Trans.		Watts, John I., Fairleigh, Hartford, Cheshire
1888			Way, Edward J., F.I.C., c/o R. H. Harland, 37, Lombard-street, E.C.
1883	Trans.		Webster, C. S. Stanford, Malvern House, Redland, Bristol

Date of Election.		
1866		Webster, G. W., 33, Bridge-street-row, Chester
1877		Webster, William, 50, The Park, Blackheath, S.E.
1889		Weir, P. A., Lieut.-Col., I.M.S., M.B., Sutna, E.I.R., India
1898		Weissmüller, E. C., Assistent des Kantons-Chemikers, Bern, Switzerland
1888		Welch, J. Cuthbert, Trail, British Columbia
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen N., The Gas Co., Colombo, Ceylon
1884	Trans.	Wells, James S. C., Ph.D., Columbia University, New York City, U.S.A.
1890		Wells, S. Russell, B.Sc., M.B., 24, Somerset-street, Portland-place, W.
1897		Welsh, John, 12A, Seller-street, Chester
1888	Trans.	Werner, Emil A., 5, Church-avenue, Rathmines, Dublin
1886		Wertheimer, Julius, Prof., B.Sc., B.A., F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, C. A., Royal College of Science, South Kensington, S.W.; and 95, Oakhill-road, East Putney, S.W.
1899		West, G. H., B.Sc., Frankwell, Llanidloes
1898		Weston, F. E., 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry A., Messrs. Parke, Davies & Co., Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence, J. de, 131, Pepys-road. New Cross, S.E.
1893		Whalley, Sidney, B.Sc., Lond., 29, Norman-road, Canterbury
1894		Wheeler, H. L., Ph.D., The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest,
1897		Wheelwright, E. W., B.A., Ph.D., Greenholme, Westfield-road, Acock's-green, near Birmingham
1897		While, A. J., Whinsfield, Barrow-in-Furness
1896		Whimster, J. I., 43, Tynemouth-road, South Tottenham, N.
1898		Whitaker, E. T., M.B., B.Sc., Southfield, Kingsland, Shrewsbury
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford, Yorkshire
1899		White, A. Lee, B.Sc., 3A, Crabb-tree-lane, Fulham Palace-road, S.W.
1893		White, H. C., Prof., The University, Athens, Georgia, U.S.A.
1891		White, Henry, 11 Carter Knowle-road, off Abbeydale-road, Sheffield
1899		White, H. Fox, 52 Royal York-crescent, Clifton, Bristol
1882		White, Leedham, 2, Lime-street-square, E.C.
1889		‖White, John Isawoo, M.A., F.I.C., Treasury Office, Bassein, Lower Burmah
1897		White, P. T., Horton Field, West Drayton, Middlesex

Date of Election.			
1893			White, William Gilchrist, 75, West End-villas, Broadbottom, near Manchester
1885			Whitehead, Henry H., Holland House, Isleworth, W.
1896			Whitehead, James, 8, West-street, Rochdale
1889			Whitehouse, William, Albany House, Bradmore, Wolverhampton
1886	Proc.		Whiteley, R. Lloyd, 20, Beeches-road, W. Bromwich
1892			Whiteside, John Lowe, 51, Cannon-street, Bolton
1863			Whitfield, John, 113, Westborough, Scarborough
1899			Whittaker, C. J., Willow House, Blackburn-road, Accrington
1893			Whittaker, Thomas, Ravensmere, St. Annes-on-the-Sea
1889			Whittam, Matthew, M.A., The Isle of Wight College, Ryde
1889			Wigan, Basil P., Rhondda Valley Brewery Co., Treherbert
1895			Wigley, H. F. A., Etruria, Gravesend
1896			Wigner, J. H., Ph.D., Eden House, Burrell-square, Crieff, N.B.
1896			Wilcox, A. J., Plowden Hall, Lydbury North, Salop
1891			‖Wild, John, Bredbury House, Bredbury, Stockport
1889			‖Wild, W. E., B.Sc., 230, Turton-road, Bromley Cross, near Bolton
1897	Trans.		Wilderman, Meyer, Ph.D., B.Sc., Davy-Faraday Laboratory, Albemarle-street, W.
1881			Wilkes, J. P., 54½, Old Broad-street, E.C.
1893			Wilkinson, John, The Gas Works, Drighlington, near Bradford
1885			Will, Wm. Watson, 1, St. Agnes-place, Kennington Park, S.E.
1891			Will, W., Prof., Ph.D., Colonie Grunewald, Boothstr. 32, bei Berlin.
1862	Trans.		‖Williams, C. Greville, F.R.S., F.I.C., 36, Kenilworth-avenue, Wimbledon, SW.
1895			Williams, Evan, Gas Works, Rochdale-road, Manchester
1892			Williams, John, Government Laboratory, British Guiana
1883	Proc.		Williams, Rowland, Sunny Lea, Aldcliffe-road, Lancaster
1891			Williams, Seward W., c/o Seabury and Johnson, 8, Brighton-avenue, East Orange, New Jersey, U.S.A.
1872			‖Williams, Thomas, Chemical Laboratory and Assay Office, A, Queen-avenue, 10, Dale-street, Liverpool
1899	Proc.		Williams, W. A., 32, High-street, Market Harborough,
			‖Williams, Walter Collingwood, B.Sc., 68, Grove-street, Liverpool
1885			‖Williams, W. Carleton, B.Sc., 23, Broomgrove-road, Sheffield
1874	Trans.		Williams, William, County Offices, Westgate-street, Cardiff, and
1892	Trans.		63, Plymouth-road, Penarth
			Williams, W. J., 2215, Bridge-street, Frankford, Philadelphia,
1878			U.S.A.
1848	Trans.	C. 1850-3 58-60 V.P. 54-7 61-2 P. 63-5 69-71	‖Williamson, A. W., LL.D., F.R.S., High Pitfold, Haslemere

Date of Election.		
1898		Williamson, J. A., 14, Milton-avenue, Highgate, N.
1874	Trans.	‖Williamson, Robert, Low Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Esher, Surrey
1898		Williamson, William, 86, Tyndall-road, Leyton, E.
1896		Wills, E. Chaning, M.A. Cantab., Eastdown House, East Down, Barnstaple
1872		Wills, Jos. Lainson, 133, Midwood-street, Flatbush, Brooklyn, New York, U.S.A.
1892	Trans.	Wilsmore, N. Y. M., Herzberger Chaussee 31, Göttingen, Germany
1885		Wilson, A. C., Borough Hall, Stockton-on-Tees
1894		Wilson, A. Poole, c/o Commissioners of National Education, Education Office, Marlborough-street, Dublin
1879		‖Wilson, Charles J., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, D.Sc., Carbeth, Killearn, by Glasgow
1899		Wilson, F. R. Leyland, M.A., Charterhouse, Godalming
1855		Wilson, G. F., F.R.S., Heatherbank, Weybridge Heath
1895		Wilson, H., 146, High-street, Southampton
1875		‖Wilson, James, M.A., Barrister-at-Law, 2, Essex-court, Temple; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, 6, Fenchurch-buildings, E.C.
1895	Proc.	Wilson, John, B.Sc., Battersea Polytechnic, S.W.
1899		Wilson, John, 73, Melford-road, Leytonstone, E.
1891		Wilson, John Henry, A.I.C., 29, Radford-street, Coventry
1890		Wilson, J. Mitchell, M.D., Medical Officer of Health, Doncaster
1900		Wilson, L. P., 123, Chadwick-road, East Dulwich, S.E.
1894		Wilson, R. H.,
1871		‖Wilson, William John, c/o Paget Prize Plate Co., Watford
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich
1874		Wiltshire, Thomas Pemberton, c/o Tartar Chemical Company, 9th-street and Gowanus Canal, Brooklyn, New York, U.S.A.
1887		Winder, Bartlett W., Sunny Bank House, 43, Broomhall-place, Sheffield
1893		Winder, Edward Humphreys, Westminster School, S.W.
1894		Wingate, Hamilton M., B.Sc., Maratoto, New Zealand
1895		Wingfield, T. R., 5, Bromwich-street, Bolton
1876		Winser, Percy James, Heath Field, Bebington, near Birkenhead
1891		Winterton, A. W., Nenedale House, Wellingborough
1898		Witham, Ernest, The Grammar School, Rotherham
1876	Trans.	Witt, Otto N., Geh. Rath, Prof., Ph.D., 21, Siegmundshof, Berlin, W.
1896		Wolfenden, J. H., B.Sc., 13, Elm-street, Failsworth, Manchester
1867		Wood, Augustus A., 1 and 2, Queen-street, Cheapside, E.C.
1889		Wood, Charles, 21, Queen's-road, Bradford, Yorks

Date of Election.			
1860	Trans.		‖Wood, Charles Henry, 16, Festing-grove, Southsea
1890			Wood, Sidney, B.Sc., S. Kensington Museum, S.W.
1898	Trans.		Wood, T. B., M.A., M.D., Gonville and Caius College, Cambridge
1884			Wood, William H., B.A. (Oxon.), La Martinière, Calcutta
1871	Trans.		Woodcock, Reginald C., The Sanitas Co., Ltd., 636 to 642, West 55th-street, New York City, U.S.A.
1898			Woodhead, S. A., B.Sc., Agricultural College, Uckfield, Sussex
1898			Woods, C. W. T., 10, Tudor-road, Upper Norwood, S.E.
1892			‖Woods, Hugh, Westbury, Hornsey-lane, N.
1888			Woodward, James, B.Sc., B.A., F.I.C., 46, Selborne-road, Ilford, Essex
1889			Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1889			Woosnam, Richard W., 1, The Chase, Wavley Mount, Brentwood, Essex
1899			Wormell, T. W., B.Sc., 6, Walsingham-road, St. Andrews, Bristol
1884			‖Worrall, J. Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858	Trans.		‖Worsley, Phillip J., Rodney Lodge, Clifton, Bristol
1898			Wrench, C. A., 3, Parklands, Surbiton-hill, S.W.
1895			Wright, H. E., c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1878	Trans.		Wright, Lewis Thompson, 10, Norland-square, Holland Park, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		Wright, William T., 102, Derbyshire-lane, Sheffield
1891			Wyatt, Thomas M., Chemical Department, Royal Arsenal, Woolwich, S.E.
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, W. Fitzthomas, Wheatley-street, Coventry
1885	Trans.	{C.1892-6 S. 98-9}	Wynne, W. Palmer, D.Sc., F.R.S., Royal College of Science South Kensington, S.W.
1874	Trans.		Yates, Robert, 64, Park-street, Southwark, S.E.
1886			Yoshida, H.,
1885			Young, Alfred C., 64, Tyrwhitt-road, St. John's, S.E.
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, F. S., M.A., Nonconformist Grammar School, Bishops Stortford
1877	Trans.		‖Young, Frank W., Woodmuir, West Newport, Fife, N.B.
1890			‖Young, George, Ph.D., University College, Sheffield
1895			Young, H. Stow, c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 4, Plumstead Common-road, Woolwich, S.E.
1877			Young, J. Rymer, 42, Sankey-street, Warrington
1874			Young, John, 164, Bath-street, Glasgow

Date of Election.			
1898			Young, J. H., B.Sc., 115, Birmingham-road, Oldbury, Birmingham
1887			Young, John William, B.Sc., B.A., 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	||Young, Sidney, Prof., D.Sc., F.R.S., University College, Bristol; and 10, Windsor-terrace, Clifton, Bristol
1873			||Young, W. C., Normanhurst, High-road, Romford; and Chemical Laboratory, 19/20, Aldgate, E.C.
1878			Zingler, Maximilian, 19, Buckland-crescent, Belsize Park, N.W.; and 16, Fenchurch-street, E.C.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XVII. Nos. 231—244.
JANUARY—DECEMBER, 1901.

EDITED BY THE SECRETARIES.

LONDON
GURNEY & JACKSON, 1, PATERNOSTER ROW,
1902.

Richard Clay and Sons, Limited
LONDON AND BUNGAY

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£20 to G. D. Lander, to continue the study of the synthesis and properties of imino-ethers, and to extend the method of alkylation by silver oxide and alkyl iodides.

£20 to A. W. Crossley, to investigate the hydrolysis of substituted dihydroxyresorcinols.

£10 to H. Sand, to continue his research on changes of concentration at the electrodes in a solution of an organic compound in which no convection currents of the liquids take place.

Re-appropriation of balance of last grant to J. McCrae, to prepare and optically examine some amide derivatives of *l*-malic acid.

£5 to E. P. Perman, to continue his research on the vapour pressures of aqueous ammonia solution.

£5 to G. Dean, to investigate the action of bromine upon silver cyanate.

£5 to T. S. Patterson, to continue his research on the influence of solvents on the rotation of optically active compounds.

£15 to K. J. P. Orton and A. E. Garrod, to investigate the change of tyrosin into homogentisic acid and allied reactions.

£30 to J. J. Hummel and A. G. Perkin, to investigate the constitution of certain natural colouring matters.

£20 to W. A. Bone, to continue his investigations on alkyl substituted succinic and tricarballylic acids.

£5 to R M. Caven, to continue his investigation of the organic derivatives of phosphorus oxychloride, and for the investigation of amidines of the type OP(NHR)NR and the questions of tautomerism arising therefrom.

£5 to R. H. Pickard, to investigate the constitution of cholesterol.

£5 to R. H. Pickard, to investigate the condensation reactions of monosubstituted biurets, and the formation of ring compounds from these and the corresponding allophanates.

£5 to D. R. Boyd, to further investigate the aromatic ethers of glycerol.

£10 to J. B. Cohen, to investigate the law which determines substitution by chlorine and bromine in presence of a halogen carrier.

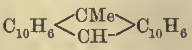
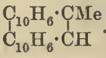
£25 to A. Lapworth, to investigate the oximes of hydroxy- and amidocamphor, and the intra-conversion of tautomeric forms.

£10 to A. E. Tutton, to continue his chemico-crystallographical investigation of the selenates.

£20 to J. Wade, to continue his investigation of the isocyanides as bearing on the constitution of hydrogen cyanide and the mechanism and conditions of isomeric change.

£10 to H. O. Jones, to further investigate certain cases of stereoisomerism and the causes which produce optical activity and govern the production of optically active substances.

£15 to A. W. Crossley and H. R. Le Sueur, to investigate substituted dihydrobenzenes.

£10 to W. H. Mills, for experiments on the synthesis of the hydrocarbons  $C_{10}H_6{<}\begin{matrix}\mathrm{CMe}\\ \mathrm{CH}-\end{matrix}{>}C_{10}H_6$ and  $\begin{array}{l}C_{10}H_6\cdot \mathrm{CMe}\\ \,|\qquad\quad\;\; |\\ C_{10}H_6\cdot \mathrm{CH}\end{array}$.

LIST OF FELLOWS ELECTED DURING 1901.

Name.	Proposed.	Elected.
Adams, Ormsby Gore	May 2nd, 1901	June 20th.
Aitken, Andrew Charles	December 6th, 1900	February 7th.
Allen, Frederick T., B.Sc.	November 7th, 1901	December 5th.
Anderson, William C., M.A., D.Sc.	February 7th, 1901	May 2nd.
Ashwell, Guy	April 18th, 1901	June 20th.
Aspinall, Thomas	,, ,,	,, ,,
Aston, William George	,, ,,	,, ,,
Baker, Arthur	November 7th, 1901	December 5th.
Baker, Thomas Thorne	June 20th, 1901	,, ,,
Ball, Walter Craven, B.A.	November 7th, 1901	,, ,,
Barker, Hubert Haigh	May 16th, 1901	June 20th.
Barrie, Thomas Stewart	December 6th, 1900	February 7th.
Beaven, Edwin Sloper	April 18th, 1901	June 20th.
Bedford, Frederick	,, ,,	,, ,,
Bedwell, John Cardew, B.Sc.	December 6th, 1900	February 7th.
Bennet, Andrew Russell	November 7th, 1901	December 5th.
Bickford, Harding	,, ,,	,, ,,
Blake, George Stanford	February 7th, 1901	May 2nd.
Bolton, Edward Richards	,, ,,	,, ,,
Bousfield, Edward G. P.	February 21st, 1901	,, ,,
Boyers, Henry	November 7th, 1901	December 5th.
Bridges, Joseph Samuel, B.Sc.	May 2nd, 1901	June 20th.
Bult, Herbert John	December 6th, 1900	February 7th.
Burgess, Percival J., M.A.	January 17th, 1901	May 2nd.
Burrows, Merrick W., M.Sc.	December 20th, 1900	February 7th.
Burton, William, B.Sc.	November 7th, 1901	December 5th.
Carter, William	February 7th, 1901	May 2nd.
Clark, Ernest, B.Sc.	March 7th, 1901	,, ,,
Cockburn, Thomas Kennedy	,, ,,	,, ,,
Coddington, Eustace, B.A.	March 7th, 1901	May 2nd.
Cohen, Robert Waley, B.A.	December 20th, 1900	February 7th.
Cormack, William	November 7th, 1901	December 5th.
Cousins, Herbert H., M.A.	November 15th, 1900	February 7th.
Crabtree, Arthur	April 18th, 1901	June 20th.
Crocker, Walter Stevens	January 17th, 1901	May 2nd.
Crookes, Samuel Irwin	June 6th, 1901	December 5th.
Crossley, Frank	November 7th, 1901	,, ,,
Dakin, Henry Drysdale	February 7th, 1901	May 2nd.
Daniel, Gilbert Howard, B.Sc.	December 6th, 1900	February 7th.
Davidson, John Howard, B.Sc.	November 7th, 1901	December 5th.
Davis, Francis	,, ,,	,, ,,
Dean, George, M.A.	May 16th, 1901	June 20th.
Dodd, Robert	November 15th, 1900	February 7th.
Donnan, Frederick G., M.A., Ph.D.	December 6th, 1900	,, ,,
Dubois, Raymond, B.Sc.	January 17th, 1901	May 2nd.
Duckworth, William Henry	March 21st, 1901	,, ,,
Dunstan, Albert Ernest, B.Sc.	February 21st, 1901	,, ,,
Eastick, Samuel Philip	March 21st, 1901	,, ,,
Eling, Thomas H. J., B.A.	May 16th, 1901	June 20th.

Name.	Proposed.	Elected.
Ellis, Hugh Edward	March 7th, 1901	May 2nd.
Emery, John Alfred	December 6th, 1900	February 7th.
English, Robert	November 7th, 1901	December 5th.
Eyre, John Vargas	March 7th, 1901	May 2nd.
Ferguson, Reginald W.	December 20th, 1900	February 7th.
Gadd, Henry Wippell	November 7th, 1901.	December 5th.
Gajjar, T. K., M.A., B.Sc.	November 21st, 1901.	,, ,,
Gardner, Hermann Charles T.	November 7th, 1901.	,, ,,
Gillman, Edward	,, ,,	,, ,,
Groves, William Peer, B.A.	November 7th, 1901.	,, ,,
Haddon, Henry Edward	January 17th, 1901	February 7th.
Hammond, Herbert Blackmore	June 6th, 1901	December 5th.
Hanley, John	February 7th, 1901	May 2nd.
Hanson, Edward K., B.A.	May 16th, 1901	June 20th.
Harding, Herbert	November 7th, 1901.	December 5th.
Harrison, John A., B.Sc.	February 7th, 1901	May 2nd.
Harry, Frederick Thomas	May 16th, 1901	June 20th.
Henley, Francis R., B.A.	March 7th, 1901	May 2nd.
Higgs, Henry Herbert, B.Sc.	February 7th, 1901	,, ,,
Hobson, Edwin	June 20th, 1901	December 5th.
Horton, Edward	May 16th, 1901	June 20th.
Houldershaw, Arthur	November 15th, 1900.	February 7th.
Howard, Bernard Farmborough	December 6th, 1900	,, ,,
Hughes, Edward	November 15th, 1900.	,, ,,
Hutton, Robert Salmon, M.Sc.	,, ,,	,, ,,
Hyder, Alfred James	February 21st, 1901	May 2nd.
Ingram, Beresford, B.A.	November 7th, 1901.	December 5th.
Ionides, Stephen Archigenes	November 15th, 1900.	February 7th.
Jameson, J. S.	November 21st, 1901.	December 5th.
Jemmett, William Henry C., B.A.	February 21st, 1901	May 2nd.
Johnson, Charles H., M.B., Ch.M.	June 20th, 1901	December 5th.
Jollyman, Walter Henry	November 7th, 1901.	,, ,,
Jones, Major J. L. T., I.M.S.	December 20th, 1900.	February 7th.
Jones, Robert Henry, M.Sc.	November 15th, 1900.	,, ,,
Kettle, James David, B.Sc.	November 7th, 1901.	December 5th.
Kiddell, Christopher George	May 16th, 1901	June 20th.
Bruce-Kingsmill, J., M.A., B.Sc.	November 7th, 1901.	December 5th.
Larter, Alfred Tabois	,, ,,	,, ,,
Lattey, Robert Tabor, B.A.	May 16th, 1901	June 20th.
Leahy, Albert W. D.	November 21st, 1901.	December 5th.
Lehmann, Adolf L. F., B.Sc., Ph.D.	May 2nd, 1901	June 20th.
Lewis, Ernest Alfred	March 21st, 1901	May 2nd.
Linde, H. T. G. van der	November 15th, 1900.	February 7th.
Loewenthal, Oscar	January 17th, 1901	May 2nd.
Lowson, William, B.Sc.	May 2nd, 1901	June 20th.
Macdonald, F. G.	May 16th, 1901	,, ,,
Macdonald, Peter	November 7th, 1901.	December 5th.
Martin, Nicholas Henry	December 6th, 1900	February 7th.

Name.	Proposed.	Elected.
McKenzie, Alexander, M.A., Ph.D., D.Sc.	March 21st, 1901	May 2nd.
McLaren, Daniel, B.Sc.	April 18th, 1901	June 20th.
Mees, C. E. K.	March 7th, 1901	May 2nd.
Menzies, James	December 20th, 1900	February 7th.
Meredith, William	November 15th, 1900	,, ,,
Millard, Charles K., M.D., D.Sc.	November 7th, 1901.	December 5th.
Miller, Edward Holl	June 20th, 1901	,, ,,
Moir, James, M.A., B.Sc.	November 15th, 1900	February 7th.
Müller, Christian	June 6th, 1901	December 5th.
Murphy, Albert John	February 7th, 1901	May 2nd.
Neil, Arthur Theodore, B.A.	,, ,,	,, ,,
Neumann, Edgar, B.A., Ph.D.	March 21st, 1901	,, ,,
Newbould, Herbert Simpson	June 20th, 1901	December 5th.
Nunn, Arthur W.	December 20th, 1900	February 7th.
Oldershaw, William	March 21st, 1901	May 2nd.
Oram, Frank	May 16th, 1901	June 20th.
Page, Theodore Henry	December 6th, 1900	February 7th.
Parkes, Albert Edward	November 7th, 1901.	December 5th.
Pay, Walter Herbert	November 21st, 1901	,, ,,
Peacock, Arthur, B.Sc.	March 7th, 1901	May 2nd.
Pollitt, Charles James Tomlin	November 7th, 1901.	December 5th.
Potter, Rowland Samuel	June 6th, 1901	,, ,,
Powell, John, B.Sc.	April 18th, 1901	June 20th.
Price, Thomas Slater, Ph.D., D.Sc.	December 6th, 1900	February 7th.
Purvis, John Edward, M.A.	May 16th, 1901	June 20th.
Radcliffe, Lionel Guy	December 6th, 1900	February 7th.
Ramsden, William Cecil	,, ,,	,, ,,
Robertson, William	February 7th, 1901	May 2nd.
Robinson, William Hammond, M.A.	March 7th, 1901	,, ,,
Royle, Charles Leonard	November 7th, 1901.	December 5th.
Russell, James Bertram, B.Sc.	May 2nd, 1901	June 20th.
Ryffel, John Henry, B.A., B.Sc.	November 7th, 1901.	December 5th.
Sandford, Allan	June 20th, 1901	,, ,,
Sandford, Thomas	May 2nd, 1901	June 20th.
Scott, George Charlton	November 7th, 1901.	December 5th.
Scott, Herbert Kilburn	December 20th, 1900	February 7th.
Sheppard, Samuel Edward	May 2nd, 1901	June 20th.
Shepperson, William	February 21st, 1901	May 2nd.
Sherratt, C. Edmund Shaw	,, ,,	,, ,,
Sherwood, Edward Charles, M.A.	November 7th, 1901.	December 5th.
Sichel, Gerald T. S.	May 16th, 1901	June 20th.
Slefrig, Samuel, B.Sc.	March 21st, 1901	May 2nd.
Smith, Andrew Biggam	May 2nd, 1901	June 20th.
Smith, Henry Ewing	March 7th, 1901	May 2nd.
Smith, Harry Metcalfe	November 15th, 1900	February 7th.
Smith, James	March 21st, 1901	May 2nd.
Smith, Norman, B.Sc.	November 7th, 1901.	December 5th.
Spence, John Davidson	April 18th, 1901	June 20th.
Stell, Samuel Fenton	February 7th, 1901	May 2nd.
Stephenson, Robert, jun., B.A.	June 6th, 1901	December 5th.

Name.	Proposed.	Elected.
Talbot, John, B.A., B.Sc.	December 6th, 1900.	February 7th.
Tankard, Arnold Rowsby	May 16th, 1901	June 20th.
Tatam, George William G.	May 2nd, 1901	,, ,,
Taylor, William Henry	March 7th, 1901	May 2nd.
Templeman, William Henry	November 7th, 1901.	December 5th.
Thomas, Albert Edward, B.Sc.	December 20th, 1900	February 7th.
Tozer, Herbert Ackermann, B.A.	January 17th, 1901	May 2nd.
Varley, Harold Foy F.	November 7th, 1901.	December 5th.
Verteuil, Joseph de	April 18th, 1901	May 2nd.
Wade, Frank	June 6th, 1901	December 5th.
Wager, Morton	,, ,,	,, ,,
Wallace, Herbert George	November 7th, 1901.	,, ,,
Waterhouse, J.	December 6th, 1900.	February 7th.
Wayland, William A.	,, ,,	,, ,,
Welch, George Edward, B.Sc.	February 7th, 1901	May 2nd.
Whitehouse, Philip Lewington	November 7th, 1901.	December 5th.
Whittle, James	May 2nd, 1901	June 20th.
Whitton, William Arthur	April 18th, 1901	,, ,,
Wilson, Duncan R., B.A.	May 16th, 1901	,, ,,
Wilson, J. S., M.D., C.M.	December 6th, 1900.	February 7th.
Wylie, Adam Storer	February 7th, 1901	May 2nd.

FELLOWS DECEASED.

Name.	Elected.	Died.
Beale, F. J.	May 4th, 1899.	May, 1901.
Beckett, John Hampden	May 4th, 1882	October 3rd, 1901.
Bird, Henry	June 4th, 1874	February, 1901.
Gilbert, Sir Joseph Henry	May 18th, 1841	December 23rd, 1901.
Hartridge, Alfred	December 1st, 1898	October 9th, 1901.
Hislop, Lawrence	April 21st, 1898	May, 1901.
Holliday, Robert	December 2nd, 1880	April 2nd, 1901.
Johnson, David	February 4th, 1875	December 17th, 1901.
Leonard, Norman	February 15th, 1894	November 26th, 1901.
Macadam, Stevenson	February 21st, 1853	January 24th, 1901.
Madan, H. G.	May 1st, 1862	December 22nd, 1901.
Morris, G. Harris	February 19th, 1880	December 30th, 1901.
Shapleigh, Waldron	February 20th, 1873	September 24th, 1901.
Siebold, Louis	November 19th, 1874	November 4th, 1901.
Spivey, W. T. N.	April 21st, 1898	October 25th, 1901.
Terrill, William	March 1st, 1877	July 24th, 1901.
Thomson, John	April 15th, 1858	September 3rd, 1901.
Thudichum, John L. W.	December 20th, 1860	September 7th, 1901.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1901.

	Page in Proceedings.	Page in Transactions.
January 17th.		
1. The preparation of iodic acid. By A. Scott and W. Arbuckle	2	302
2. Note on isomeric change and meta-substitution in benzenoid amines. By A. Lapworth	2	—
3. The preparation of esters from other esters of the same acid. By T. S. Patterson and C. Dickinson	4	280
4. Tecomin. A colouring matter derived from *Bignonia tecoma.* By T. H. Lee	4	284
5. A new method for the measurement of ionic velocities in aqueous solution. By B. D. Steele, B.Sc.	5	414
6. Metal-ammonia compounds in aqueous solution. Part II. The absorptive powers of dilute solutions of salts of the alkali metals. By H. M. Dawson and J. McCrae	5	493
7. The amide, anilide, and toluidides (ortho- and para-) of glyceric acid. By P. F. Frankland, F. M. Wharton, and H. Aston	6	266
February 7th.		
8. The action of hydrogen bromide on carbohydrates. By H. J. H. Fenton and Mildred Gostling	22	361
9. The ketonic constitution of cellulose. By C. F. Cross and E. J. Bevan	22	366
10. Note on a method for comparing the affinity values for acids. By H. J. H. Fenton and H. O. Jones	24	—
11. Organic derivatives of phosphoryl chloride and the space configuration of the valencies of phosphorus. By R. M. Caven, B.Sc.	26	—
12. $\alpha\alpha$-Hydroxycamphorcarboxylic acid. By A. Lapworth and E. M. Chapman	28	377
13. The bacterial decomposition of formic acid. By W. C. C. Pakes and W. H. Jollyman	29	386
14. Preparation of substituted amides from the corresponding sodamide. By A. W. Titherley, M.Sc., Ph.D.	29	391
15. Note on two molecular compounds of acetamide. By A. W. Titherley, M.Sc., Ph.D.	31	413
16. Diacetamide; a new method of preparation. By A. W. Titherley, M.Sc., Ph.D.	31	411

	Page in Proceedings.	Page in Transactions.
17. Organic derivatives of silicon. By F. S. Kipping and L. L. Lloyd	32	449
18. Isomeric hydrindamine camphor-π-sulphonates. Racemisation of α-bromocamphor. By F. S. Kipping	32	370
19. Tetramethylene carbinol. By W. H. Perkin, jun.	33	329

February 21st.

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January 17th, 1901. Professor THORPE, C.B., F.R.S., President, in the Chair.

Messrs. E. F. Hudson, H. A. Auden, and A. H. Mitchell were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Percival James Burgess, Singapore; Raymond Dubois, Rutherglen, Victoria; Oscar Loewenthal, Mill Hill Park, London, W.; Walter Stevens Crocker, 25, Upper Parliament Street, Liverpool; Herbert Ackerman Tozer, 113, Stepney Green, London, E.

The following letter has been sent, at the direction of the Council, to Professor Markownikoff of the University of Moscow, a Foreign Member of the Society, on the occasion of the commemoration of the 40th year of his Doctorate.

DEAR SIR,

At the last meeting of the Council of the Chemical Society I had the pleasure of submitting your letter of December 8th, concerning the proposed celebration in honour of Prof. Dr. Wladimir Markownikoff. I am instructed by the Council to inform you that it will not be possible for any of our Fellows to be present personally on February 25th, but I am to ask you to be so good as to convey to Prof. Markownikoff the hearty congratulations of our Society, and to express the wish that he may be spared to carry on his valuable and important investigations for many more years. We rejoice that your distinguished countryman's name appears in our list of Foreign Members, and I beg you to convey to him the assurance that his long devotion to that science which he has done so much to advance by his researches is most highly appreciated by English chemists.

Yours obediently,
RAPHAEL MELDOLA,
Foreign Secretary.

DR. H. DECKER.

Of the following papers, those marked * were read :—

*1. "The preparation of iodic acid." By A. Scott and W. Arbuckle.

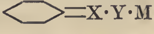
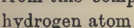
The usual method of preparing iodic acid by gently boiling iodine with nitric acid in a flask with a long neck, is tedious when any quantity is required and liable to great loss of iodine unless the source of heat is very carefully regulated. By using, first the ordinary form, and later a modified form, of Soxhlet's fat extraction apparatus to contain the iodine, almost theoretical yields of iodic acid were obtained after a very short treatment with the boiling nitric acid. The liability, however, of the siphon tube to become choked with crystals of iodic acid led to the abandonment of this type of apparatus. After many trials with various forms of apparatus, the authors recommend the use of a round-bottomed flask having a ground-in neck carrying two tubes, to one of which is sealed a reflux condenser, and through the other is fitted a tube by means of which a current of oxygen is passed through the boiling liquid. With this apparatus *finely powdered* iodine boiled with ten times its weight of fuming nitric acid may be completely oxidised in 20—30 minutes.

*2. "Note on isomeric change and meta-substitution in benzenoid amines." By A. Lapworth.

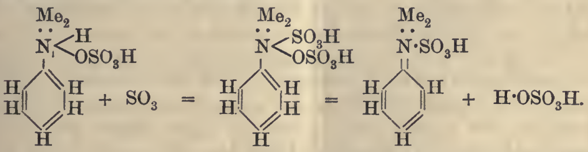
The rules deduced from the two simplest change forms (*Trans.*, 1898, **73**, 457) depend on the assumption made implicitly throughout the paper, that only one group can "migrate" along any chain of atoms at any instant, that is, that exchange of groups is, as a rule, the result of the successive migration of the two groups in reverse directions. This view appears in general to be well founded, and it is easily demonstrated that if it holds true, the rules deduced are necessarily correct, the second being used where the valency of an atom alters. It is of no consequence whatever how the migration is effected, so far as the applicability of the rules is concerned.

Although in applying the rules it is sometimes convenient to assign successive positions of attachment of a labile group in its migration, it is not imagined that these are actually occupied, at least in the ordinary sense of the term. It may be supposed, for example, that the group is handed on in a still dissociated state from its initial to its final position, the others merely representing the possible places of attachment.

The author has advanced the view that *meta*-substitution is the result of elimination of a hydrogen atom in the benzenoid nucleus (necessarily from the *meta*-position) with a group in the complex formed by union of the side chain with the acting agent. Armstrong has recently used a similar conception in explaining the formation of chloracetanilides from phenylacetylchloramines; in the author's opinion, this would lead to the production of the *meta*-derivative, instead of, as is the case, the *ortho*- and *para*-derivatives (compare *Trans.*, 1900, 77, 1051).

In alluding to the formation of *meta*-sulphonic acids from benzenoid amines (*loc. cit.*, p. 457), the author suggested that it was the result of the migration of the $-SO_3H$ group in aniline sulphates; this view must be rejected as impossible, as the necessary grouping is not present. The statement that *meta*-derivatives are formed when the labile group M is separated from the benzene ring by two atoms only holds true when the grouping  is present or can be formed as an intermediate step. M will migrate to the *meta*-position when separated by one atom only, from the nucleus if the intermediate compound is of the type , and X is able to fall in valency by two units, for example, when X is a pentavalent nitrogen atom.

Applying this to the case of the action of fuming sulphuric acid on dimethylaniline, the most probable explanation of the reaction is that dimethylaniline sulphate unites with sulphuric anhydride, and that from this compound sulphuric acid is then eliminated by loss of a hydrogen atom from the nucleus thus



The latter substance must yield the meta-sulphonic acid if the sulpho-group then migrates, assuming, as usual, that the other atoms retain their positions until this migration has ended. Or, expressing it in terms of the author's rules, as the sulpho-group migrates the valency of the nitrogen must fall, since it cannot become attached to the nucleus by a treble binding; the nearest possible position of attachment for the labile group is, therefore, the β-position, hence, as the valencies of the carbon atoms remain constant, the next position must be imagined to be reached by an $\alpha\gamma$-change. This process can also be followed by using Thiele's rule, but, in this case, it must be assumed that sulphuric acid is added in one way and eliminated in another, and as for this purpose it must be supposed that before addition it breaks up into HO and $\cdot SO_3H$ instead of into H and OSO_3H, the objection to this hypothesis is obvious.

3. "The preparation of esters from other esters of the same acid." By T. S. Patterson and C. Dickinson.

Experiments were described which had for their object the preparation of methyl ethyl tartrate. A substance was obtained having the observed rotation $+11{\cdot}14°$ at $18°$ ($l = 200$ mm.), which probably consisted chiefly of the compound sought. It showed no tendency to crystallise and as no method of purification, other than crystallisation, was likely to be suitable, these attempts to obtain a pure compound were abandoned. They had shown, however, that ethyl tartrate is largely converted into methyl tartrate by the action of methyl alcohol and hydrochloric acid. Experiments were then described showing that pure ethyl tartrate can be obtained from methyl tartrate and pure methyl tartrate from ethyl tartrate, by Fischer's method, hence it is probable that any other ester may be prepared by an analogous process, under certain circumstances this might prove useful.

Finally determinations of the rotation of methyl tartrate at temperatures between 20° and 100° were given.

4. "Tecomin. A colouring matter derived from 'Bignonia tecoma'." By T. H. Lee.

The new colouring matter is a yellow, crystalline, substance soluble in alcohol with an orange colour, insoluble or very slightly soluble in water; the solution becomes rose-red with alkalis and clear yellow with acids; 2 c.c. $N/100$ alkali or acid causes the colour change; it is not affected by any but the strong mineral acids, but the presence of organic acids renders the end reaction indistinct. The wood contains a reddish-brown resin soluble in alcohol from which it is difficult to free the tecomin; also a deep brown colouring matter which dissolves in aqueous alkalis and is precipitated by acids. It is used locally as a dye for cotton and as a stain for wood.

5. "A new method for the measurement of ionic velocities in aqueous solution." By B. D. Steele, B.Sc.

The author described a new method for the direct measurement of ionic velocities in aqueous solution. Masson (*Phil. Trans.*, 1899, **192**, A, 331) has succeeded in obtaining satisfactory measurements in gelatine, and for a few ions; Whetham (*Phil. Trans.*, 1893, **184**, A, 337) has made measurements in water. The method now described should be a perfectly general one, as the use of coloured indicator solutions is no longer necessary, and hence the range of ions which may be used as indicators is largely increased.

The method consists in enclosing the liquid to be measured between two partitions of gelatine, which contains the indicator ion in solution; on the passage of the current the cation of the solution is followed by the cation of the indicator, and the anion of the solution by the corresponding anion of the indicator. It is necessary in all cases that these indicator ions should move more slowly than the measured ion.

The position of the boundary between the two solutions is easily seen, on account of the difference in refraction, and the motion is measured by means of a cathetometer. If the above-mentioned condition is fulfilled the relative velocity of the boundary is not influenced by changing the indicators, thus ($CuSO_4$ and K_2CrO_4), ($CuSO_4$ and $NaC_2H_3O_2$), and ($CdSO_4$ and $NaC_2H_3O_2$) all gave the same value for the transport number of $MgSO_4$.

The absolute velocity of a few ions has also been calculated and compared with the velocities found by Kohlrausch, and a very fair agreement is shown to exist between the two sets of measurements.

6. "Metal-ammonia compounds in aqueous solution. Part II. The absorptive powers of dilute solutions of salts of the alkali metals." By H. M. Dawson and J. McCrae.

The influence exerted by the addition of salts of the alkali metals on the distribution of ammonia between water and chloroform at 20° has been investigated. It has been found that so long as the ammonia concentration in the aqueous phase is less than 0·5 normal, the alteration of the distribution coefficient is proportional to the salt concentration, that is, the expression $\frac{k-k'}{n}$ is constant, where k is the distribution coefficient with pure water (26·28), and k' is the observed. distribution coefficient with salt solution of normality n. This constant it is proposed to call the "equivalent alteration of the distribution coefficient."

The alteration for each salt is composed additively of two values, one dependent upon the cation, the other upon the anion. Since, according to the views of Abegg and Bodländer, "ammonia-complex" formation takes place only with the cation, the differences in the values of the alteration for salts of one metal express the differences in the physical actions of the anions; but differences in the values for salts containing the same anion do not measure the differences in the physical actions of the cations because of the complicating influence of complex formation. The lithium salts show the greatest tendency to form ammonia addition compounds, ammonium salts show it to a less degree, whilst for sodium salts it is probably very small, but greater than for potassium salts.

When the ammonia concentration is greater than 0·5 normal, irregularities occur, and it has been found that for increasing salt concentration and constant ammonia concentration the value of $\frac{k-k'}{n}$ decreases, whilst for constant salt concentration and increasing ammonia concentration it increases.

Non-electrolytes (urea and cane sugar) also considerably affect the distribution coefficient, so that Dalton's law is not obeyed.

These results indicate that the solvent power of water is changed to a varying extent by the different ions. The intrinsic property of the ion which is the cause of this difference is not deducible from the ionic theory as it stands at present.

7. "The amide, anilide, and toluidides (ortho- and para-) of glyceric acid." By P. F. Frankland, F. M. Wharton, and H. Aston.

These compounds have been prepared by the authors with the object of investigating the influence on the rotation produced by replacing the alkoxyl group by the amido-group and its substituted derivatives. After a review of the limited number of cases at present available for ascertaining these relations, the authors pointed out that so far it was observable that if in an homologous series of ethereal salts the rotation is raised by successive additions of CH_2, then the amide has a similar but still higher rotation than the ethereal salts, but that if the successive additions of CH_2 lead to diminished rotation, then the corresponding amide has a lower rotation than the ethereal salts. The first of these relations is exhibited by the derivatives of tartaric, malic, and glyceric acids, whilst the only hitherto known example of the second is furnished by the corresponding derivatives of mandelic acid.

The result of substituting in the amido-group appears in all cases to be an increase in the rotatory effect of the latter. In the case of malic acid, the anilide has a greater molecular rotation than the amide, the *o*-toluidide greater still, and the *p*-toluidide the greatest of all. In the case of glyceric acid, on the other hand, although the anilide has a greater molecular rotation than the amide, the rotation of the *p*-toluidide is less than that of the anilide, and the rotation of the *o*-toluidide is about the same as that of the amide.

The amido-compounds prepared by the authors appear to be the only ones which have hitherto had their rotation determined in the liquid state; in the case of the *o*-toluidide, however, this could unfortunately not be effected, as this, on fusion, at once acquired a strong colour. In consequence of this, the rotation of all the compounds in question was determined also in methyl alcohol solution.

The corresponding compounds of inactive glyceric acid were also prepared, and their melting points compared with those of the active substances.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on Wednesday, March 27th, 1901, the day preceding that fixed for the Annual General Meeting. Further particulars will shortly be announced.

At the next meeting, on February 7th, there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"The action of hydrogen bromide on carbohydrates." By H. J. H. Fenton and Mildred Gostling.

"Note on a method of comparing the affinity-values of acids." By H. J. H Fenton and H. O. Jones.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, February 7th, 1901.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

Aitken, Andrew Charles,
Rio Marina, Isola d'Elba, Italy.

Analytical Chemist. Six years assistant to Messrs. Tatlock and Thomson, Analytical Chemists, Glasgow. Two years sole Chemist with the White Lead Company, Limited, Glasgow. For the last two years representative in Elba for Messrs. H. Borner and Co., Limited, London.

R. R. Tatlock. Horatio Ballantyne.
R. T. Thomson. Robt. D. Connell.
James E. Ferguson.

Barrie, Thomas Stewart,
77, Sinclair Drive, Langside.

Principal of the West of Scotland College of Pharmacy, 157, St. Vincent Street, Glasgow. Student of Chemistry at Grove Street Public School 1891—1893, Technical College 1893—1894, both in Glasgow; also in Crumphill Public School, Paisley, 1894—1895; gained the Minor Qualification (Oct., 1896) and the Major Diploma (Jan., 1898) of the Pharmaceutical Society of Great Britain; elected a Member of that body, 1900. Teacher of Chemistry at the West of Scotland College of Pharmacy, Glasgow, and Consulting Chemist there. Author of a book on "Volumetric Analysis" adapted for pharmaceutical students, and contributor of various articles dealing with the analysis of arsenates, lactophosphates, calamine, iodides, &c., to the *Pharmaceutical Journal* and the *Chemist and Druggist* during the years 1899 and 1900.

G. G. Henderson. Thos. Maben.
James Robson. *Thomas Gray.*
Matthew A. Parker.

Bedwell, John Cardew, B.Sc. (London),
65, High St., Colchester.

Private Tutor and Science Teacher. For 3 years Assistant Lecturer on Chemistry at Colchester Technical College. Student at Technical Laboratory, Chelmsford 1 year, and at Colchester Technical College 3 years. Desirous to obtain Society's Journal for assistance in research.

Thos. S. Dymond. William Briggs.
Frank Hughes. *W. A. Shenstone.*
J. W. Shepherd.

Bult, Herbert John,
165, Brixton Hill, S.W.

Chemist. Three years student at Finsbury Technical College. Two years in laboratory at St. George's Hospital, last 18 months as Chief Assistant. For some time in charge of laboratory of Messrs. Thomas Farmer and Co., Silvertown. Two years Chief Assistant to Dr. P. Dvorkovitz, Petroleum expert. One year Head Chemist and Assistant Engineer at European Petroleum Co.'s Thames Haven Refinery. Some time chemist to Mr. A. Adiassewich, Petroleum expert. Three years private practice.

R. Meldola. Lawrence Briant.
Boverton Redwood. F. Southerden.
Arthur J. Starey.

Burrows, Merrick William,
Dunkirk, Devizes ; 4, St. George's Terrace, Wilton, Taunton.

Science Master (Huish School, Taunton). For three years, 1891—1894, student in Owens College Chemical Department. B.Sc. Vict., Hons. Chemistry, 1894. M.Sc. 1898. Assisted Prof. Dixon in research on the action of carbonic acid on heated carbon 1894—1895.

H. B. Dixon. G. H. Bailey.
W. H. Perkin, jun. William A. Bone.
D. L. Chapman.

Cohen, Robert Waley,
11, Hyde Park Terrace, London, W.

B.A. Cambridge. Has long been interested in Chemistry, and proposes to devote himself to some branch of Industrial Chemistry. Made Chemistry an important subject at Cambridge, and desires to join the Society in order to continue and extend his knowledge of the subject by means of its meetings and publications.

W. A. Shenstone. H. J. H. Fenton.
H. E. Roscoe. W. T. N. Spivey.
C. T. Heycock.

Cousins, Herbert Henry,

Government Laboratories, Kingston, Jamaica.

Government Analyst and Agricultural Chemist. First Class Hon. Chemistry, Oxford. M.A. Eighteen months in laboratory of V. Meyer, Heidelberg. Assistant Demonstrator to Waynflete Professor, Oxford. Lecturer on Chemistry, University Extension. Lecturer on Chemistry at S.E. Agricultural College, Wye. Now Chemist for Jamaica. Paper with J. E. Marsh in *Trans.*, 1891. "Farm Foods," 1895. "Chem. of Garden," 1898. Researches on hop analysis, insecticides, manuring of crops, &c.

John Percival.
A. D. Hall.
W. W. Fisher.
V. H. Veley.
J. E. Marsh.

Daniel, Gilbert Howard,

21, Church Walk, Ulverston.

Head Master, Higher Grade and Technical Schools, Ulverston. B.Sc. (Lond.), 1890. Registered Teacher (South Kensington) in Prac. and Theor. Org. Chem. and in Prac. and Theor. Inorg. Chem. Head Master of Maryport Higher Grade School and Chemistry Lecturer in the Evening Classes also, 1891–97. Head Master of Bristol North Street Higher Grade School and Evening Class Lecturer, 1897–1900.

J. H. Haynes.
R. L. Taylor.
R. S. Cahill.
F. W. Wormell.
James Foulds.

Dodd, Robert,

28, Sibella Road, Clapham, S.W.

Student at King's College. Now Chemist in Boracic Acid Works. One year at the "Allan Glen's School," Glasgow. Three years St. Clement Danes Schools. Student in the Chemical Department King's College, London, during 1896—1897, 1897—1898.

John M. Thomson.
Herbert Jackson.
Patrick H. Kirkaldy.
Thos. A. Cheetham.
Oscar Guttmann.
B. E. R. Newlands.
Arthur R. Ling.
Rudolph Messel.

Donnan, Frederick George, M.A., Ph.D.,

Chemical Laboratory, University College, Gower Street, W.

Assistant, Chemical Department, University College, Gower Street, W. Author of following papers: "An Attempt to give a simple Theoretical Explanation of Raoult's Law," *Phil. Mag.*, Nov., 1892, 411; "Electrolytic Dissociation and Light-Absorption in Solutions," *Zeitschr. Phys. Ch.*, 19, 465; "The Saturation-Pressures of the

System, Mg·K·Cl·SO_4," *Sitz. Ber. Akad.*, 52, 1897; "Theory of the Thomson-Effect in a Binary Electrolyte," *Phil. Mag.*, June, 1898, 529; "Theory of the Hall-Effect in a Binary Electrolyte," *Phil. Mag.*, Nov., 1898, 465; "The Isothermal Pressure-Surface for one Double and two Single Salts," *Journ. Phys. Ch.*, 2, 417; "The Nature of Soap Emulsions," *Zeitschr. Phys. Ch.*, 31, 42; "Relative Rates of Effusion of Helium, Argon, and some other Gases," *Phil. Mag.*, May, 1900, 423.

William Ramsay.	Edward C. Cyril Baly.
Morris W. Travers.	Alex. M. Kellas.
Vaughan Harley.	J. Nevill Huntly.

Emery, John Alfred,

Cinderford, Gloucestershire.

Head Master. Higher Grade Bd. Schools, Cinderford, Glos. Superintendent Teacher of Physics and Chemistry in above schools. Holder of Certificates in above subjects under Science and Art Dept., South Kensington. Teacher of Pupil Teachers' Classes in Chemistry, &c.

J. Jackson.	*Sydney Young.*
Thomas Edwards.	*F. Wallis Stoddart.*
Thos. W. Berry.	*Austin Keen.*

Ferguson, Reginald Williams, A.R.C.S.,

8, Havelock Terrace, Paisley Road, Glasgow.

Senior Assistant in the Chemical Department of the Leeds Institute of Science, Art and Literature. National Scholar in Chemistry and Physics; Associate (in Chemistry) of the Royal College of Science, London. "Stenhouse Scholar" and Associate of the Glasgow Technical College. For 6 years a Student of Chemistry under, successively, Prof. Dittmar, Prof. Thorpe, and Prof. Tilden. Since 1895 engaged in lecturing on Chemistry in the schools of the Leeds Institute, and in the management of a large Chemical Laboratory.

T. E. Thorpe.	W. Palmer Wynne.
William A. Tilden.	George Ward.

Thomas Fairley.

Houldershaw, Arthur,

71, Lavender Gardens, West Jesmond, Newcastle-on-Tyne.

Science Instructor in Chemistry, Physiology, and Hygiene in Elementary School. Studied Inorganic and Organic Chemistry for many years, and secured several Certificates in same at South Kensington Exams. 1st Class Certificates in advanced Physiology (Queen's Prize, 1892, one of five), and Hygiene, and Teacher of these subjects for some years under Science and Art Department. Reasons: To become better acquainted with recent researches in Chemistry by means of the Journal of the Society, and to participate in the privileges granted to Fellows.

T. W. Lockwood. *Joseph Brown.*
I. Patchett. *R. S. Cahill.*
Frank R. Dudderidge. *Oliver Kirk.*
W. Goddard.

Howard, Bernard Farmborough,
Devon House, Buckhurst Hill, Essex.

Chemical Student at the City and Guilds of London Institute, Technical College, Finsbury. Educated at Marlborough College, 1894—1898. Since then Chemical Student under Professor Meldola, F.R.S., F.I.C., F.C.S., at Technical College, Finsbury.

R. Meldola. F. Southerden.
David Howard. D. Lloyd Howard.
Alfred G. Howard.

Hughes, Edward,
Rectory, Barmouth.

Clerk in Holy Orders. I am much interested in Chemistry, practical and theoretical, and desire to avail myself of the publications of the Society. I was a pupil of Prof. Vacher, Editor of *Fresenius Quant. and Qual. Analyses.*

Watson Smith. Thomas Wardle.
R. Le Neve Foster. *W. F. Keating Stock.*
Alex. K. Miller.

Hutton, Robert Salmon, M.Sc.,
Owens College, Manchester.

Demonstrator in Electrochemistry. Student for 4 years in Chemical Laboratories, Owens College. B.Sc. Hons. Chem., 1897. Has investigated the "Compound Line Spectrum of Hydrogen" given by specially purified hydrogen (*Phil. Mag.*, Sept., 1898). Has studied physical chemistry for 2 years in Leipzig under Prof. Ostwald, and in Paris under Prof. Moissan.

H. B. Dixon. G. H. Bailey.
W. H. Perkin, jun. E. J. Russell.
William A. Bone. D. L. Chapman.

Ionides, Stephen Archigenes,
Balliol College, Oxford.

Student of Chemistry at Balliol College, Oxford.

D. H. Nagel. A. F. Walden.
H. B. Hartley. P. Elford.
H. L. Bowman.

Jones, John Lloyd Thomas Major, I.M.S.,

United Service Club, Calcutta.

Deputy Assay Master, Calcutta, and lately for 1½ years Acting Assay Master, Calcutta. Bachelor of Medicine, University of Durham. Member of the Royal College of Surgeons, England. Diplomate of Public Health, Cambridge University. Passed the Course of Instruction in Assaying at the Royal College of Science, South Kensington, and Royal Mint, London.

W. C. Roberts-Austen.
F. W. Bayly.
T. K. Rose.
Chapman Jones.
T. E. Thorpe.
W. J. Russell.

Jones, Robert Henry,

Glen Albyn, Coity Road, Bridgend, Glam.

Science Master, County School, Bridgend, Glam. B.Sc. (Vic.). 1st Class Hon. in Chem. 1896. Research Student with Prof. Dixon 1896—8. Dalton Chemical Scholar of Owens College, 1897. Original work: "Instantaneous pressure produced on Collision of two Explosion Waves," Manch. Lit. and Phil. Soc. M.Sc. (Vic.), 1899. 1898—9 Science Master, Wellington Coll., Salop; 1899, Science Master, County Sch., Bridgend.

H. B. Dixon.
W. A. Bone.
W. H. Perkin, jun.
E. J. Russell.
H. C. H. Carpenter.

van der Linde, Harold Theodor Granville,

101, Tyndall Avenue, Toronto, Canada.

Chief Chemist, Gutta Percha and Rubber Manufacturing Co. of Toronto. Above position (with average of four assistants) for past seven years, previous to which I was Manager (with charge of chemical laboratory) to the Edison General Electric Co. (manufacturing every description of electric appliance and insulated conductor) in Canada, for four years. At Edinburgh University passed in first B.Sc. and first and second M.B., C.M. Exams.

Alex. Crum Brown.
W. H. Ellis.
Charles G. Cresswell.
G. G. Henderson.
David Howard.

Martin, Nicholas Henry,

Ravenswood, Low Fell, Gateshead, and Royal Societies Club, London.

Pharmaceutical Chemist. Manufacturer of pure chemicals. Chairman of the Newcastle Section of the Society of Chemical Industry.

P. Phillips Bedson.
Alexander Scott.
Wyndham R. Dunstan.
F. C. Garrett.
S. Hoare Collins.

Menzies, James,

39, Winterbrook Road, Herne Hill, London, S.E.

Chemical Engineer. Studied chemistry and passed examinations at Clausthal Mining College, Germany, afterwards in the Berlin "Polytechnik." Was 2½ years with D. A. Sutherland, Esq., F.C.S., F.I.C., as Assistant. At present with J. C. Butterfield, Esq., F.I.C., F.C.S., M.I.M.M., M.R.I.

D. A. Sutherland. Robert N. Lennox.
James Mactear. J. C. Butterfield.
Thomas Fairley.

Moir, James, M.A., B.Sc.,

The Ash, 62, Hamilton Place, Aberdeen, Scotland.

1851 Exhibition Scholar, Aberdeen University. Joint author with Dr. Japp of paper on "Constitution of Amarine, its so-called Dialkyl- and Diacyl-derivatives, and of Isoamarine" (*J. C. S.*, May, 1900). Lately Junior Assistant, Chemical Department, Aberdeen University. At present Research Student at Central Technical Inst., South Kensington.

Henry E. Armstrong. Gerald T. Moody.
F. R. Japp. W. A. Davis.
T. Martin Lowry.

Meredith, William,

63, Albion Place, Ulverston.

Lecturer for 15 years in Chemistry and Physics. Superintendent of Evening Continuation School. At Ulverston I have no means of access to the Society's Journal, and I should find it of real interest and benefit to me in my work.

Wm. Cranfield. G. S. Turpin.
A. E. Tutton. *Chapman Jones.*
James C. Philip.

Nunn, Arthur W.,

313, Sydenham Road, Sydenham, S.E.

Analytical Chemist. Has been for 12 years and is now engaged in analytical work, chiefly foods and drugs. Has contributed several papers on Pharmaceutical Chemistry, *e.g.* "On a supposed change in Calomel when kept in contact with Sugar for a long time." Has passed the Major Examination of the Pharmaceutical Society. Has delivered public lectures in his parish.

John Attfield. C. A. Hill.
W. Watson Will. W. Chas. Sayers.
H. A. D. Jowett.

Page, Theodore Henry,

40, Wilson Road, Camberwell, S.E.

At present employed in Research Laboratories of London Essence Co., George Street, Camberwell. Associate of City and Guilds of London Institute (Chem. Dept.).

Henry E. Armstrong.
William J. Pope.
Gerald T. Moody.
T. M. Lowry.
Edwin C. Jee.
William A. Lethbridge.

Price, Thomas Slater,

University College, Sheffield.

Demonstrator in Chemistry. "The Amyl (Secondary Butyl Methyl) derivatives of Glyceric, Diacetylglyceric and Dibenzoylglyceric acids, active and inactive" (*Journ. Chem. Soc.*, 1897, p. 253) (in conjunction with Prof. Frankland.). "Die Reaktion zwischen Kaliumpersulphat und Iodkalium, und Katalyse bei derselben," *Zeit. f. Phys. Chemie*, **27**, 474; "On the Temperature Coefficient of Ester saponification," *Swedish Academy*, 1900; "The Reaction between Ethyl Alcohol and Hydrochloric Acid," *Proceedings Chem. Soc.*, Nov., 1900. 1851 Exhibition Scholar in Chemistry, 1896—1899. Ph.D. (Leipzig), 1898. D.Sc. (Lond.), 1900. A.I.C., Jan., 1900.

W. Carleton Williams.
Percy F. Frankland.
Henry J. S. Sand.
George Young.
W. R. Innes.

Radcliffe, Lionel Guy,

6, Alma Terrace, Old Trafford, Manchester.

Lecturer in Chemistry. Lectures on Organic and Inorganic Chemistry, at the Municipal Technical School, Manchester; also had experience in Technical Chemistry in Colour Works. Has also published original work on the following subjects: On "Curcumine" (*Journal of Society of Dyers and Colourists*); on "Carthamine" (*ibid.*); "The Oximes of Indigotin and Indirubin, &c." (*ibid.*); together with Dr. L. Marchlewski, "Zur Kenntniss des Indigotins" (*Journal für praktische Chemie*) and in (*Ber. d. deutschen Chem. Ges.*) "Note on the constitution of Indican, &c." (*Journal Soc. of Chem. Industry*), &c.

W. H. Perkin, jun.
Edw. Schunck.
John Allan.
Jas. Grant.
Jul. Hübner.

Ramsden, William Cecil,

13, Effra Road, Rathmines, Dublin.

Junior Assistant and Demonstrator. I was a student in the Chem. Dept. of Univ. Coll. Nottingham, for over 3 years, then acted as Lecture Assist. to Prof. Snape, U.C.W., Aberystwyth, for 3 years, and am now Junior Assistant and Demonstrator to Prof. J. E. Reynolds, T.C., Dublin, with whom I was associated in some work on the electrolytic estimation of bismuth. This work has been published in a short article.

J. Emerson Reynolds. Frank Clowes.
Emil A. Werner. J. Bernard Coleman.
Edward T. Shelbourn.

Scott, Herbert Kilburn,

P.O.B. 634, Rio de Janeiro, Brazil.

Mining Engineer, Metallurgist, and Analytical Chemist (consulting). Was with Dr. E. Riley, City Road, London, in 1892. Later Chemist Elba Iron Mines, afterwards, 1895, Chief Engineer and Manager. Manager, Manganese Mines, Brazil, 1895–1900. Now established in Rio de Janeiro as above. Author of "Iron Mines of Elba," 1895, "Manganese Ores of Brazil," 1900 (*Proc. Iron and Steel Institute*).

Edwd. Riley. B. A. Burrell.
Archie H. Strong. Robt. D. Connell.
James E. Ferguson.

Smith, Harry Metcalfe,

79, Helix Road, Brixton, London, S.W.

Analytical Chemist. Fellow of the Institute of Chemistry. Member of the Society of Public Analysts. Now, and for 10 years past, Assistant to Dr. Thos. Stevenson, Guy's Hospital. Joint author with Norman Leonard, B.Sc., of a number of papers on analytical subjects contributed to *The Analyst.*

Thos. Stevenson. Charles E. Groves.
William Ramsay. J. Norman Collie.
Norman Leonard.

Talbot, John,

Tunstall House, Harrow.

Assistant Science Master at Harrow School. Late Scholar of Trinity College, Cambridge. B.A. (Camb.), 1st Class, parts I and II, Nat. Science Tripos. B.Sc. (Lond.), Exhibitioner in Chemistry and Physics, and Medal in Physics at Intermed. B.Sc. First Class Honours Physics, Final B.Sc.

M. M. Pattison Muir. T. B. Wood.
S. Ruhemann. W. T. N. Spivey.
R. S. Morrell. B. P. Lascelles.

Thomas, Albert Edward, B.Sc. (Lond.), A.I.C.,

34, South Road, Kingswood, Bristol.

Assistant Lecturer on Chemistry and Physics, Merchant Venturers' Tech. Coll., Bristol. B.Sc. (Lond.), with Honours in Chemistry and Physics. A.I.C. by examination. First Class Honours in Theor. and Pract. Inorganic Chemistry, &c. (South Kensington). 5½ years' teaching experience as above.

J. Wertheimer.	Arnold Philip.
G. P. Darnell-Smith.	Ernest H. Cook.

Sydney Young.

Waterhouse, James,

Oak Lodge, Court Road, Eltham, Kent.

Major-General, Indian Staff Corps. Late Assistant Surveyor-General of India, in charge Photographic and Lithographic Office, S.I.D., Calcutta. Has published original researches on the action of eosin and other dyes on photographic plates; on the action of thiocarbamides in reversing the photographic image on gelatine dry plates; and on the sensitiveness of silver to light.

R. Meldola.	John Spiller.
Chapman Jones.	Charles H. Bothamley.

J. W. Swan.

Wayland, William A.,

4, Harefield Road, Brockley, S.E.

Manufacturing and Analytical Chemist. A manufacturer of chemicals, also analyst, specialising water, malt, hops, &c. Interested in chemistry in its relation to the brewing and sugar industries.

William J. Pope.	Herbert F. Fermor.
Stanley J. Peachey.	Alfred W. Harvey.

Arthur H. Coote.

Wilson, James Scott,

Bradford St., Walsall.

Medical Officer of Health. M.D., C.M. Glas. Univ. D.P.H. Camb. For twelve months a student in the Laby. of Dr. B. Hill, Birmingham, and at present engaged in chemical work in connection with Public Health.

Alfred Hill.	James Robt. Kaye.
Chas. A. MacMunn.	*Frank Clowes.*

J. B. Coleman.

The following Certificate was authorised by Council under Bye-Law I (3):—

Haddon, Henry Edward,

Pamplemousses, Mauritius.

Chemist of the "Beau Plan" Sugar Estates Company, Limited. Analytical Chemist of the Faculté de Medicine et Pharmacie de Lyon. Ex-Chemist of the "Sucrerie Centrale" de Meaux, Seine et Marne, France. Ex-Chemist of the "Las Angustias" factory, Granada, Spain. Member of the Chemical Society of Paris. Member of the Association des Chimistes de Sucreriès, France. Author of several papers on cafetannic acid and milk. Ex-Ag. Assistant Director of the "Station Agronomique" of Mauritius.

Vivian B. Lewes.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

Issued 15/2/1901

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 232.

February 7th, 1901. Professor Thorpe, C.B., F.R.S., President, in the Chair.

Messrs. R. M. Caven and J. B. Harrison were formally admitted Fellows of the Society.

The following certificates were read for the first time:—William Carrick Anderson, 2, Florentine Gardens, Hillhead, Glasgow; George Stanfield Blake, Purley Lodge, Purley, near Croydon; Edward Richards Bolton, 7, Leazes Terrace, Newcastle-on-Tyne; William Cárter, 7, Victoria Street, Clitheroe; Henry Drysdale Dakin, 9, Beech Grove Terrace, Leeds; John Hanley, 4, Guion Road, Litherland, Liverpool; John Ansted Harrison, 47, London Road, Neath, Glamorganshire; Henry Herbert Higgs, 26, Anglesey Street, Lozells, Birmingham; Albert John Murphy, Preston House, Leeds; Arthur Theodore Neil, 21, South Grove, Highgate, N.; William Robertson, 41, Rosenau Road, Battersea Park, S.W.; Samuel Fenton Stell, 20, Henry Street, Keighley; George Edward Welch, 88, Caledonian Road, Leeds; Adam Storer Wylie, 93, Manchester Street, Oldham.

THE ADDRESS TO THE KING.

The President read the following Address, which the Council that afternoon had resolved to present to his Majesty the King. He moved that the Fellows of the Society should join with the Council in paying respect to the memory of the illustrious Queen they had so recently lost and in offering their homage to the new Sovereign. This was seconded by the Treasurer and carried unanimously, the Fellows all standing.

To His Most Gracious Majesty King Edward VII.

May it please your Majesty.

We, the President, Council, and Fellows of the Chemical Society, beg leave to approach your Majesty with expressions of deep sympathy in the grievous loss which your Majesty and the Empire have sustained through the death of our revered Sovereign, Queen Victoria, during whose beneficent reign the science of Chemistry, for the promotion of which her Majesty granted the Society a Royal Charter, has made immense progress.

We recall with gratitude the leading part which your illustrious Father, the Prince Consort, took in securing the extension of scientific knowledge in this country, and especially the great assistance he rendered in the foundation, in the year 1845, of the Royal College of Chemistry (since developed into the Royal College of Science), of which College he became the President.

We desire respectfully to congratulate your Majesty on your accession to the Throne, and most heartily to wish your Majesty a long, happy, and prosperous reign.

We venture to express the hope that your reign may be marked by discoveries in the science we represent not less brilliant than those which have characterised the reign of her late Majesty.

Signed on behalf of the Chemical Society,

T. E. THORPE, *President.*
W. A. TILDEN, *Treasurer.*
WYNDHAM R. DUNSTAN, } *Honorary*
ALEXANDER SCOTT, } *Secretaries.*
R. MELDOLA, *Foreign Secretary.*

THE DAY AND HOUR OF MEETING.

Mr. F. J. Lloyd asked whether the President could give any information as to the reasons which had led the Council to issue its recent circular requesting the views of the Fellows on a proposal to change the day and hour of the Ordinary Meetings of the Society.

The President, in reply, said that he was glad to take advantage of the opportunity which Mr. Lloyd had afforded him to state the attitude of the Council on the question. The expediency of an alteration in the day and hour of meeting had been mooted on more than one occasion, though no action was taken till the question was formally raised at a recent meeting of Council. The Secretaries were thereupon directed to issue with the "Journal" for this month the circular and card referred to, with the view of eliciting the opinions of the Fellows upon the subject.

With respect to Mr. Lloyd's question as to the reasons for the inquiry, he might remind the Fellows that a great change had come over the social life of London during the fifty or sixty years of the Society's existence. A great number of what used to be called the 'resident' Fellows now lived in suburbs which were extending in all directions more and more widely. Moreover, the facilities or reaching town had been so enormously increased that it seemed worth while inquiring whether a rearrangement of the day and hour of meeting would render it possible for the country Fellows to attend the meetings of the Society in greater numbers than at present. He (the President) thought it would thus be seen that the Counci had good *primâ facie* grounds for testing the opinion of the general body of Fellows.

He might add that more than half of the cards issued had been returned, and of these a very large majority were in favour of the suggested alteration. No exact analysis had as yet been made, but the Fellows might be interested to know that those in favour of the change were in the ratio of about four or five to one. Of the 'resident' Fellows about two to two and a-half to one were in its favour. He expressed a wish that the remaining cards should be returned as quickly as possible so that the Council might have the opportunity of considering the replies, and of dealing with the matter, if necessary, at the Annual General Meeting.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected :—

Andrew Charles Aitken, Thomas Stewart Barrie, John Cardew Bedwell, B.Sc., Herbert John Bult, Merrick W. Burrows, M.Sc., Robert Waley Cohen, B.A., Herbert H. Cousins, M.A., Gilbert Howard Daniel, B.Sc., Robert Dodd, Frederick G. Donnan, M.A., Ph.D., John Alfred Emery, Reginald W. Ferguson, Henry Edward Haddon, Arthur Houldershaw, Bernard Farmborough Howard, Edward Hughes, Robert Salmon Hutton, M.Sc., Stephen Archigenes Ionides, Major J. L. T. Jones, I.M.S., Robert Henry Jones, M.Sc., H. T. G. van der Linde, Nicholas Henry Martin, James Menzies, William Meredith, James Moir, M.A., B.Sc., Arthur W. Nunn, Theodore Henry Page, Thomas Slater Price, Ph.D., D.Sc., Lionel Guy Radcliffe, William Cecil Ramsden, Herbert Kilburn Scott, Harry Metcalfe Smith, John Talbot, B.A., B.Sc., Albert Edward Thomas, B.Sc., Major-Gen. J. Waterhouse, William A. Wayland, J. S. Wilson, M.D., C.M.

Of the following papers, those marked * were read :—

*8. "The action of hydrogen bromide on carbohydrates." By H. J. H. Fenton and Mildred Gostling.

It was previously shown by the authors (*Trans.*, 1898, **73**, 554, and 1899, **75**, 423) that bromomethylfurfuraldehyde results when hydrogen bromide acts upon lævulose, sorbose, inulin, or cane sugar, and it was shown that the formation of this substance is characteristic of ketohexoses or of substances which give rise to them on hydrolysis. The experiments have now been extended, using a higher temperature and chloroform as the solvent. Under these conditions, all forms of *cellulose* give large yields of bromomethylfurfuraldehyde, and the results appear conclusively to prove that cellulose must contain a grouping or nucleus similar to that in lævulose. An account was also given of the behaviour of several other carbohydrates under similar conditions.

*9. "The ketonic constitution of cellulose." By C. F. Cross and E. J. Bevan.

Having received a private communication of the results obtained by Fenton and Gostling, which are described in the preceding note, it has been deemed opportune to state fully the experimental evidence available for the solution of the problem of the constitution of cellulose.

For the view that cellulose is a near analogue of starch, that is, a polyanhydride of dextrose, the evidence is slender, resting mainly (1) on the well established empirical formula $(C_6H_{10}O_5)_n$ and (2) on the somewhat superficial study of the products of ultimate hydrolysis by Braconnot (*Ann.*, 1819, [ii], **12**, 172) and Flechsig (*Zeit. Physiol. Chem.*, 1883, **7**, 523).

The later evidence comprises the following items: (a) The tetracetate (Cross and Bevan) appears to be an ester of the unresolved cellulose (anhydride) with a formula $C_6H_6O\cdot(OAc)_4$, from which may be deduced as probable, the ketonic formula $CO{:}(CHOH)_4{:}CH_2$ for the cellulose unit; (b) Will and Lenze have shown (*Ber.*, 1898, **31**, 68) that the ketoses yield nitric esters with two ester groups less than the corresponding aldoses, two hydroxyl groups being condensed by internal reaction. Cellulose giving a trinitrate (C_6) with yields less than the theoretical (for the simple ester reaction) conforms with this general character of the ketoses and their anhydrides; (c) Faber and Tollens (*Ber.*, 1899, **32**, 2595), in a recent study of the oxycelluloses, have identified in the soluble products of the oxidation tartaric and oxalic acids and a dibasic acid containing five atoms of carbon. *Saccharic acid was not formed.* Further, the oxycelluloses digested with calcium hydroxide yield dioxybutyric and isosaccharic acids. Acids with the normal six carbon chain are again conspicuously absent; (d) Brown and Morris (Trans., 1893, **63**, 604) have established that cane-sugar is a first product of chlorophyllic assimilation and starch is probably only a derived overflow product. Further, that cane sugar, amongst the soluble carbohydrates, has a maximum nutritive value when tested in relation to chlorophyllic assimilation (Trans., 1890, **57**, 484). A similar observation, but more directly with lævulose in relation to cellulose production, was made by A. Brown (Trans., 1886, **49**, 432).

On the above grounds, the authors had previously concluded that cellulose is not a polyaldose (anhydride), but is of ketonic constitution.

Fenton and Gostling, by condensing cellulose to methylfurfural as a main reaction, have opened an entirely new direction of experimental attack, the first result of which is at least to render the polyaldose view of its constitution questionable.

Their results directly suggest that lævulose or other ketose is the raw material for cellulose elaboration and also offer a simple explanation of the origin of unsaturated compounds such as the furfural derivatives which are constituents of the lignone complex. It also further weakens the evidence upon which all furfural yielding constituents of plants have been assumed to be pentoses or pentosanes.

Discussion.

Dr. **Horace Brown**, whilst fully admitting that a considerable amount of evidence can now be brought forward in favour of the ketonic constitution of cellulose, expressed a doubt whether the small amounts of the bromo-derivative of methylfurfural obtained by Mr. Fenton from purified starches would justify the conclusion that starch contains the carbonyl group. More evidence is required of the specific nature of the reaction, and also of the absolute freedom of the starch from traces of "starch cellulose." He was unable to add anything to the physiological evidence put forward by Dr. Morris and himself some years ago, and which certainly did appear to lend some countenance to the view that in the plant economy lævulose has some genetic connection with cellulose rather than with starch.

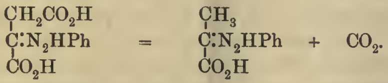
Mr. **Fenton** said that although he and his colleague were at present concerned chiefly in demonstrating a ketonic grouping or nucleus in cellulose, he considered it not at all improbable that such a grouping exists, as a fraction of the whole, in the complex molecule of starch.

The product of hydrolysis of the portion containing such a grouping may very conceivably have been overlooked in the methods of identification hitherto employed.

*10. "Note on a method for comparing the affinity values of acids."

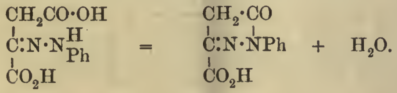
By H. J. H. Fenton and H. O. Jones.

In a former communication (*Trans.*, 1901, 79, 92), the authors described a simple method for comparing the affinity values of acids based upon the decompositions of the hydrazone of oxalacetic acid. This substance when heated with pure water yields the hydrazone of pyruvic acid and carbon dioxide :



$$\begin{array}{l} CH_2CO_2H \\ | \\ C{:}N_2HPh \\ | \\ CO_2H \end{array} \quad = \quad \begin{array}{l} CH_3 \\ | \\ C{:}N_2HPh \\ | \\ CO_2H \end{array} \quad + \quad CO_2.$$

From 83 to 90 per cent. is decomposed in this manner, the slight differences observed in different specimens depending on their purity. But in presence of acids of sufficient concentration an entirely different change occurs ; water is lost and Wislicenus' pyrazolone carboxylic acid is formed without evolution of any carbon dioxide :



$$\begin{array}{l} CH_2CO{\cdot}OH \\ | \\ C{:}N{\cdot}N^{H}_{Ph} \\ | \\ CO_2H \end{array} \quad = \quad \begin{array}{l} CH_2{\cdot}CO \\ |\quad\;\; | \\ C{:}N{\cdot}NPh \\ | \\ CO_2H \end{array} \quad + \quad H_2O.$$

With acids of insufficient concentration both changes occur simultaneously, the amount of carbon dioxide evolved being less as the concentration of the acid increases. Making exactly parallel experiments with different acids, it was shown that the volumes of carbon dioxide obtained are in the inverse order of the affinity-values of the acids.

In order to explain the nature of this influence, the authors suggest that the undissociated molecule of the hydrazone tends only to lose water, giving the pyrazolone derivative, but that the negative ion $CO_2H - CN_2HPh - CH_2CO_2$ is unstable and tends to lose carbon dioxide. Upon this hypothesis any circumstance tending to prevent ionisation should favour the production of the pyrazolone derivative, and the presence therefore of a sufficient concentration of hydrogen ions should cause the change to take place in this direction more or less completely.

Other explanations might, of course, be offered, referring, for example, to the dehydrating influence of acids or to the 'basic' character of the pyrazolone ring, and it was therefore considered advisable to make further experiments in order to ascertain whether other conditions went in harmony with the ionisation hypothesis.

The investigations had reference to the influence of (a) salts, (b) non-electrolytes, (c) acids in presence of their own salts, and (d) solvents other than water.

In all the experiments the conditions were made exactly parallel, about 0·1 gram of the hydrazone being heated to 100° with 7·5 c.c. of the liquid to be examined in the manner previously described.

The solutions examined and results obtained were as follows :—

	Weight in grams in 100 c.c.	Weight of hydrazone.	Corrected volume of carbon dioxide.
1. Pure water		0·0998	8·31 c.c.
2. Sodium sulphate (cryst.)	6	0·1000	8·75 ,,
3. Cane sugar	6	0·1005	8·12 ,,
4. Urea	1	0·1000	8·31 ,,
5. Sulphuric acid	0·49	0·1003	2·60 ,,
6. Sulphuric acid and sodium sulphate	0·49 6	0·1000	7·12 ,,
7. Acetic acid	0·6	0·1001	7·07 ,,
8. Acetic acid and sodium acetate (cryst.)	0·6 3	0·1002	8·31 ,,
9. Amyl alcohol		0·0989	3·53 ,,
10. Toluene		0·1078	2·29 ,,
11. Nitrobenzene		0·1026	2·29 ,,

Bases likewise have practically no influence ; thus 0·1001 gram hydrazone heated with a quantity of soda representing slightly *less* than 1 equivalent gave 8·58 c.c. (corr.) of carbon dioxide.

The conclusions which may be drawn from these experiments are :

(a) The influence of salts, bases, and non-electrolytes is *nil*, the results being practically identical with that given by pure water.

(b) The effect of a salt in presence of its own acid is greatly to diminish the influence of the acid, and

(c) Solvents having different ionising powers give very different results, the amount of carbon dioxide evolved being greatest in the case of water, less in amyl alcohol, and least in toluene and nitrobenzene.

With regard to the three last-named solvents, it may be remarked that, although they were carefully dried, water is produced in the pyrazolone formation, hence it is not surprising that some action should take place in a solvent such as toluene, which when pure has presumably little or no ionising power.

It is evident therefore that the results are, on the whole, well in harmony with the ionisation hypothesis, which certainly appears to offer the most satisfactory explanation of the phenomena, although other explanations are, of course, possible.

The purification of the hydrazone by recrystallisation is a troublesome and wasteful process, but the crude substance answers perfectly, since the results required are only relative. It is advisable to employ the same sample for each set of observations and the substance should be freshly prepared.

DISCUSSION.

Dr. TRAVERS remarked that the evolution of carbon dioxide from the acid seemed to take place under conditions similar to those which obtained during the electrolysis of the salt of an acid, and to be dependent on the concentration of the negative ion, in one case in the solution generally, and in the other on the surface of the anode. It would be interesting to know how the corresponding diphenylhydrazone would behave under similar conditions.

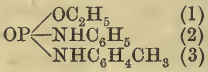
Mr. FENTON, in reply, said that one example of a disubstituted hydrazine had been investigated, namely, benzylphenylhydrazine, but that the oxalacetic derivative was extremely unstable, and only the pyruvic derivative could be isolated.

*11. "Organic derivatives of phosphoryl chloride, and the space configuration of the valencies of phosphorus." By R. M. Caven, B.Sc.

By the interaction of ethoxyphosphoryl chloride, $OP \cdot OC_2H_5 \colon Cl_2$ with two equivalents of aniline in ethereal solution, a chlorine atom is replaced and *ethoxyanilidophosphoryl chloride*, $OP \cdot OC_2H_5 \cdot NHC_6H_5 \cdot Cl$, results. This compound crystallises from ether in truncated pyramids, m. p. 61—62°. The remaining chlorine atom may be displaced by the action of *p*-toluidine, when the *ethyl ester* of *anilido-*p*-toluidophosphoric acid*, $OP \cdot OC_2H_5 \cdot NHC_6H_5 \cdot NHC_6H_4CH_3$, is obtained. This substance crystallises from dilute alcohol in needles, m. p. 116°.

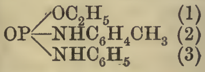
p-Toluidine and aniline may be made to react in reverse order. Thus *ethoxy-*p*-toluidophosphoryl chloride* was obtained crystallised in oblique prisms, m. p. 74°; and the *ethyl ester* of p-*toluidoanilidophosphoric acid* was found to crystallise from dilute alcohol in needles, m. p. 116—117°.

The ethyl esters obtained by these reverse processes present similar physical and microscopic characters, and an intimate mixture of the two products melts at 116—117°. Thus the two compounds



$$OP\begin{cases} OC_2H_5 & (1) \\ NHC_6H_5 & (2) \\ NHC_6H_4CH_3 & (3) \end{cases}$$

and



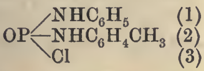
$$OP\begin{cases} OC_2H_5 & (1) \\ NHC_6H_4CH_3 & (2) \\ NHC_6H_5 & (3) \end{cases}$$

are identical, and from this it appears that the two chlorine atoms in the compound $OP \cdot OC_2H_5 \cdot Cl_2$ are similarly situated with regard to the rest of the molecule.

The only alternative to this would be the supposition that, the two chlorine atoms being differently situated, aniline and *p*-toluidine possess the power of appreciating this difference, and exercise a different predilection when reacting with the substance. This supposition, however, can hardly be entertained.

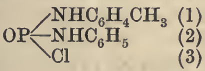
The chlorine atom replaced by the ethoxy-group might, however, differ in relative position from the other two chlorine atoms.

To determine whether this is so, aniline and *p*-toluidine were made to react directly with phosphoryl chloride, and the following compounds were obtained: *anilidophosphoryl chloride*, $\mathrm{OP{\cdot}NHC_6H_5{:}Cl_2}$, prisms, m. p. 79°; *anilido-*p*-toluidophosphoryl chloride*, $\mathrm{OP{\cdot}NHC_6H_5{\cdot}NHC_6H_4CH_3{\cdot}Cl}$, very fine needles, m. p. 133—134°; p-*toluidophosphoryl chloride*, $\mathrm{OP{\cdot}NHC_6H_4CH_3{:}Cl_2}$, plates, m. p. 106°; p-*toluidoanilidophosphoryl chloride*, $\mathrm{OP{\cdot}NHC_6H_4CH_3{\cdot}NHC_6H_5{\cdot}Cl}$, very fine needles, m. p. 133°. The two substances



$$\mathrm{OP}\left\langle\begin{array}{ll}\mathrm{NHC_6H_5} & (1)\\ \mathrm{NHC_6H_4CH_3} & (2)\\ \mathrm{Cl} & (3)\end{array}\right.$$

and

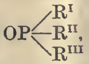


$$\mathrm{OP}\left\langle\begin{array}{ll}\mathrm{NHC_6H_4CH_3} & (1)\\ \mathrm{NHC_6H_5} & (2)\\ \mathrm{Cl} & (3)\end{array}\right.$$

present similar characteristics, and when mixed together melt at 133—134°. They are therefore identical.

It would seem then that the first and second chlorine atoms to be replaced are similarly situated, and therefore that all three chlorine atoms occupy similar positions within the molecule of phosphoryl chloride. The supposition that the chlorine atom which was at first replaced by the ethoxy-group refuses to react with bases, and is the particular atom which remains intact in these latter compounds, need scarcely be considered.

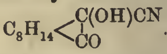
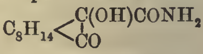
The above conclusion concerning the similarity of the chlorine atoms, if ultimately established, should be an important factor in settling the configuration of the phosphorus atom.

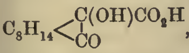
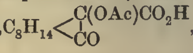
A tri-derivative, such as  $\mathrm{OP}\left\langle\begin{array}{l}\mathrm{R^{I}}\\ \mathrm{R^{II}}\\ \mathrm{R^{III}}\end{array}\right.$, in which the points of attachment of the three radicles are similarly situated in space with reference to the rest of the molecule, does not contain a plane of symmetry. It should therefore be capable of existing in right- and left-handed forms in which the phosphorus atom is the centre of optical activity. Experiments are now in progress to determine this point, and the fact that one of the elements is doubly bound to the phosphorus atom lends additional interest to the investigation, which was commenced at the suggestion of Dr. Kipping.

*12. "*a*-Hydroxycamphorcarboxylic acid." By A. Lapworth and E. M. Chapman.

An account was given of experiments begun with the view of preparing *a*-bromohomocamphoric acid, an object which has been achieved in another way (*Trans.*, 1900, **77**, 1063).

A method for preparing camphorquinone in large quantities, and free from camphoric anhydride, was described. *Camphorquinone*-p-*bromophenylhydrazone*, $C_{10}H_{14}O\colon N_2H\cdot C_6H_4Br$, is eminently suited for the detection of the quinone in small quantities; it is very sparingly soluble in nearly all organic media, and melts at 215—216°. It appears to exist only as the ketonic modification (Betti, *Ber.*, 1899, **32**, 1995). *Camphorquinonesemicarbazone*, $C_{10}H_{14}O\colon N_2H\cdot CONH_2$, which is nearly colourless at ordinary temperatures, turns yellow at 210°, melts and decomposes at 228—229°.

When camphorquinone is treated with hydrogen cyanide at −10°, a nearly colourless mass is produced, which probably consists of stereoisomeric forms of *a-dihydroxycyanocamphor*,  $C_8H_{14}<\begin{array}{l}C(OH)CN\\ \vert\\ CO\end{array}$. One of these was isolated in the form of six-sided plates, which decomposed when heated, and melted at 197—198°, approximately the melting point of camphorquinone; it had all the properties of an *a*-hydroxynitrile, and when dissolved in fuming sulphuric acid was converted into *a-hydroxycamphorcarboxylic amide*,  $C_8H_{14}<\begin{array}{l}C(OH)CONH_2\\ \vert\\ CO\end{array}$, which forms large, brilliant crystals melting, somewhat indefinitely, at 235—240°.

a-Hydroxycamphorcarboxylic acid,  $C_8H_{14}<\begin{array}{l}C(OH)CO_2H\\ \vert\\ CO\end{array}$, is formed on heating the nitrile with strong hydrobromic acid for some time. It is sparingly soluble in water, and crystallises in brilliant needles or prisms which melt and decompose at 207—208°, becoming converted into Manasse's hydrocamphor (*Ber.*, 1897, **30**, 659). The acid is converted into carbon dioxide and camphorquinone by lead peroxide and acetic acid, and is slowly decomposed when heated with alkalis, being, perhaps, converted into *dia*-homocamphanic acid (*Trans.*, 1900, **77**, 1067). *a-Acetoxycamphorcarboxylic acid*,  $C_8H_{14}<\begin{array}{l}C(OAc)CO_2H\\ \vert\\ CO\end{array}$, melts at 85—86°.

It was pointed out that these compounds must contain the carboxyl group in the position in which it occurs in camphor.

*13. "The bacterial decomposition of formic acid." By W. C. C. Pakes and W. H. Jollyman.

The authors, as the result of various observations, were led to analyse the gases produced from sodium formate in solution by certain bacteria. These experiments show that hydrogen and carbon dioxide are evolved, sodium hydrogen carbonate remaining in the medium in which the sodium formate was dissolved. The total amount of carbon dioxide, that is, the amount evolved as a gas and that in combination, was found to be equal in volume to the amount of hydrogen evolved. It is therefore possible to express the reaction by a very simple equation, either $H{\cdot}CO_2Na + H_2O = NaHCO_3 + H_2$ or $H{\cdot}CO_2H = CO_2 + H_2$. One of the chief reasons why the addition of sodium formate to media containing dextrose is of such advantage is that the alkali formed from the decomposition of the sodium formate neutralises the acids produced by the decomposition of the sugar; the fact that the medium continues to be neutral or alkaline allows the bacteria to grow for a longer period than when the medium becomes increasingly acid.

Many bacteria had no action upon the formate, and it was found that none of the more commonly occurring yeasts had any action upon the salt.

14. "Preparation of substituted amides from the corresponding sodamide." By A. W. Titherley, M.Sc., Ph.D.

The behaviour of sodamide derivatives of the type $R{\cdot}CO{\cdot}NHNa$ with various halogen organic compounds was investigated, when the marked difference observed between the aliphatic and aromatic derivatives suggested a dissimilarity in their constitution.

(a) With alkyl haloids. In presence of benzene there is no action; alcohol, if present, takes part in the reaction, giving the amide and an ether, thus: $CH_3{\cdot}CO{\cdot}NHNa + C_2H_5OH + C_2H_5I = CH_3CO{\cdot}NH_2 + NaI + C_2H_5OC_2H_5$. Sodiobenzamide in sealed tubes at 140° readily gives alkyl derivatives, $C_6H_5CO{\cdot}NHR$, in absence of alcohol, whilst sodacetamide under similar conditions undergoes complex decomposition, giving only a small quantity of the alkylacetamide.

(b) With acid chlorides in presence of benzene, sodiobenzamide behaves normally, giving diamides, $C_6H_5CO{\cdot}NH{\cdot}COR$, but sodacetamide does not give regular results. With acetyl chloride, diacetamide is formed, but with benzoyl chloride a complex change takes place, dibenzamide, tribenzamide, acetamide, diacetamide, benzonitrile, and benzoic anhydride being formed, but no acetyl benzamide.

c) With halogen esters, sodiobenzamide behaves normally, but gives only small yields of direct condensation products. Ethyl hippurate was synthesised by the action of ethyl bromacetate on sodiobenzamide. Sodacetamide gives unsatisfactory results.

(d) With bromamides, symmetrical disubstituted acyl hydrazines were expected, in accordance with the equation $R{\cdot}CO{\cdot}NHNa + R{\cdot}CO{\cdot}NHBr = R{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}CO{\cdot}R + NaBr$; but no trace of these substances was obtained, as both aliphatic and aromatic derivatives immediately undergo molecular rearrangement, giving alkyl acyl ureas, $NHR{\cdot}CO{\cdot}NH{\cdot}COR$.

It was found that the sodium atom could be best replaced by alkyl radicles by heating with potassium alkyl sulphates; for example:

With sodamide, amines are formed thus:

$$NaNH_2 + KRSO_4 = R{\cdot}NH_2 + KNaSO_4.$$

With sodium organic amides, substituted amides are formed:

$$CH_3{\cdot}CO{\cdot}NHNa + KRSO_4 = CH_3{\cdot}CO{\cdot}NHR + KNaSO_4.$$

On treatment with sodamide, the remaining hydrogen atom in the group CONHR may be replaced by sodium, and this similarly replaced by an alkyl group. The stages are:

$$R{\cdot}CO{\cdot}NH_2 \rightarrow R{\cdot}CO{\cdot}NHNa - R{\cdot}CO{\cdot}NHR^{I} \rightarrow R{\cdot}CO{\cdot}NNaR^{I} \rightarrow R{\cdot}CO{\cdot}NR^{I}R^{II},$$

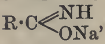
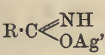
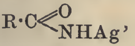
where R^{I} and R^{II} may be similar or dissimilar radicles.

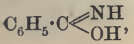
Several new monalkyl amides and mixed dialkyl amides have been thus prepared, and their behaviour, with dry hydrochloric acid and sodamide respectively, studied. The hydrochlorides of the monalkyl amides contain base and acid in the proportion of 1 mol. : 1 mol. (compare acetamide hydrochloride), and in the aliphatic group are solid, crystalline, very easily fusible, fairly stable substances; in the aromatic group, thick viscid liquids, which dissociate readily.

Acetethylamide hydrochloride, $CH_3{\cdot}CO{\cdot}NHC_2H_5,HCl$, melts at 60°; and *acet*-n-*propylamide hydrochloride*, $CH_3{\cdot}CO{\cdot}NHC_3H_7,HCl$, melts at 47°; *acet*iso*butylamide*, $CH_3{\cdot}CONH{\cdot}C_4H_9{}^{\beta}$, is a liquid boiling at 225—227°, is miscible with water, but is readily separated as an oil by adding alkali; its hydrochloride melts at 107°.

Benz-n-*proyplamide*, $C_6H_5{\cdot}CO{\cdot}NHC_3H_7$, crystallises in cubic-shaped crystals melting at 84·5°, and boiling at 294—295°.

Benzbutylamide, $C_6H_5{\cdot}CO{\cdot}NHC_4H_9$, melts at 57°, and boils with slight decomposition at 295—296°. *Acetmethylethylamide*, $CH_3{\cdot}CO{\cdot}N(CH_3)C_2H_5$, boils at 180°; and *benzmethylethylamide*, $C_6H_5{\cdot}CO{\cdot}N(CH_3)C_2H_5$, boils at 280°. Both are liquids. The sodium derivatives, $R{\cdot}CO{\cdot}NNaR^{I}$, are white powders, appreciably soluble in benzene. In the aliphatic series they dissolve unchanged in alcohol, and the solutions give, with alcoholic silver nitrate, *orange* precipitates. The aromatic sodium alkyl amides are decomposed by alcohol.

The author discussed the tautomerism of the amides and expressed the view that in the aliphatic group the sodium compounds are true sodamide derivatives of the type $R\cdot CO\cdot NHNa$, whilst in the aromatic group they are partly sodium salts of the imidohydroxy-formula,  $R\cdot C{<}^{NH}_{ONa}$, and partly $R\cdot CO\cdot NHNa$. Two series of silver derivatives have been obtained, one white, presumably  $R\cdot C{<}^{NH}_{OAg}$, and the other orange,  $R\cdot C{<}^{O}_{NHAg}$, which are capable of passing into each other and are very unstable.

The formula of benzamide itself in aqueous solution is probably  $C_6H_5\cdot C{<}^{NH}_{OH}$, and that of acetamide, $CH_3\cdot CO\cdot NH_2$.

15. "Note on two molecular compounds of acetamide." By A. W. Titherley, M.Sc., Ph.D.

Acetamide sodium bromide, $2CH_3\cdot CONH_2,NaBr$, and acetamide sodium iodide, $2CH_3\cdot CONH_2,NaI$, are well defined crystalline compounds analogous to the hydrochloride, $2CH_3\cdot CONH_2,HCl$. They were obtained as bye-products in certain reactions, and may be prepared by direct union of the constituents in the presence of alcohol. On concentration or cooling they separate as needles which begin to dissociate below their melting points and are very deliquescent. On quickly heating, $2CH_3\cdot CONH_2,NaBr$ melts at 144° with separation of NaBr, and $2CH_3\cdot CONH_2,NaI$ melts at 110° with separation of NaI. Molecular compounds with other haloid compounds of potassium and sodium do not appear to exist.

16. "Diacetamide; a new method of preparation." By A. W. Titherley, M.Sc., Ph.D.

Diacetamide may be readily prepared by the direct action of acetyl chloride (in benzene solution) on acetamide, $3CH_3CONH_2 + CH_3COCl = (CH_3CO)_2NH + 2(CH_3\cdot CONH_2)HCl$. After filtering off the insoluble acetamide hydrochloride and removing the benzene by distillation, the residue is fractionated. No previous account appears to have been given of this reaction.

Neither acetyl nor benzoyl chloride has any action on benzamide, but the benzoyl chloride gradually decomposes acetamide, with formation of benzoic acid, benzoic anhydride and acetonitrile.

17. "Organic derivatives of silicon." By F. S. Kipping and L. L. Lloyd.

Experiments on the preparation of enantiomorphously related silicon compounds were commenced nearly three years ago, and a short account of this work has already appeared (*Proc.*, 1899, **15**, 174); the much more important object, the separation of the isomerides, has not yet been attained.

When silicon tetrachloride is treated in dilute ethereal solution with one molecular proportion of a phenol or alcohol, it is decomposed in accordance with the equation $SiCl_4 + R^{I}{\cdot}OH = SiCl_3{\cdot}OR^{I} + HCl$, and by submitting the product to a similar treatment, a second group, and then a third may be introduced,

$$SiCl_3{\cdot}OR^{I} + R^{II}{\cdot}OH = SiCl_2(OR^{I})(OR^{II}) + HCl$$
$$SiCl_2(OR^{I})(OR^{II}) + R^{III}{\cdot}OH = SiCl(OR^{I})(OR^{II})(OR^{III}) + HCl.$$

Amido-compounds may be used in the above reactions in the place of alcohols or phenols with similar results.

Phenoxymethoxysilicon dichloride, $SiCl_2(OPh)(OMe)$ (b. p. 216°), and *phenoxymethoxyethoxysilicon chloride*, $SiCl(OPh)(OMe)(OEt)$ (b. p. 241°), are colourless, oily liquids readily decomposed by water; *methoxyethoxysilicon dichloride*, $SiCl_2(OMe)(OEt)$, and *methoxyethoxy*iso*butoxysilicon chloride*, $SiCl(OMe)(OEt)(OBu^{\beta})$, boiling at 128° and 160° respectively, have similar properties.

The principle on which the above reactions are based, namely, the interaction of halogen compounds and hydroxylic or amido-derivatives, is evidently capable of general application, and its use for the preparation of enantiomorphously related compounds is being investigated by one of us in the case of elements other than silicon.

18. "Isomeric hydrindamine camphor-π-sulphonates. Racemisation of α-bromocamphor." By F. S. Kipping.

In examining the salt formed by the combination of *d*-*l*-hydrindamine with *d*-camphor-π-sulphonic acid (obtained by the reduction of α-bromocamphorsulphonic acid) in order to try and isolate isomeric salts analogous to those obtained from the bromo-acid (*Trans.*, 1900, **77**, 861), it was found that although the salt at first seemed to be homogeneous, it could be resolved into fractions having different specific rotations.

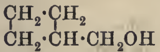
This difference in optical properties is due to the fact that the crude *d*-camphor-π-sulphonic acid contains a very small quantity of the enantiomorphously related isomeride, and as the latter can hardly have been produced during the reduction of the bromocamphorsulphonic acid, it follows that α-bromocamphor undergoes partial racemisation during sulphonation.

This change is one of considerable complexity, and necessitates the transference of part of one of the closed chains in bromocamphor from one position to another, as in the case of the optical inversion of camphor (Kipping and Pope, *Trans.*, 1897, 71, 958).

Except for the separation already referred to, the salt of *d*-*l*-hydrindamine with camphor-π-sulphonic acid undergoes no change on fractional crystallisation, and gives a molecular rotation practically identical with that of ammonium *d*-camphor-π-sulphonate; it is, therefore, a *partially* externally compensated salt of the type *d*A*l*B,*d*A*d*B; it crystallises from water in large transparent rhomboidal prisms containing water of crystallisation, and melts at about 198°.

19. "Tetramethylene carbinol." By W. H. Perkin, jun.

When the chloride of tetramethylenecarboxylic acid is reduced in moist ethereal solution with sodium, it is converted into tetramethylene carbinol,



$$\begin{array}{l} CH_2\cdot CH_2 \\ \vert \qquad\ \vert \\ CH_2\cdot CH\cdot CH_2OH \end{array}$$

, a colourless oil boiling at 143—144° and having an odour resembling that of isoamyl alcohol. The determinations of the density, refraction and magnetic rotation of this substance are given in the etailed paper.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on Wednesday, March 27th, 1901, the day preceding that fixed for the Annual General Meeting. Further particulars will shortly be announced.

At the next meeting, on Thursday, February 21st, the following papers will be communicated :

"Isomeric hydrindamine mandelates and phenylchloracethydrindamides." By F. S. Kipping and H. Hall.

"Isomeric benzylhydrindamine bromocamphorsulphonates and some salts of *d-l*-hydrindamine." By F. S. Kipping and H. Hall.

"Condensation of phenols with esters of the acetylene series. IV. Benzo-γ-pyrone and its homologues." By S. Ruhemann and H. W. Bausor.

"Constitution of bromocamphoric anhydride and camphanic acid." By A. Lapworth and W. H. Lenton.

"The action of acetylchlor- and acetylbrom-aminobenzenes on amines and phenylhydrazine." By F. D. Chattaway and K. J. P. Orton.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 233.

February 21st, 1901. Dr. ARMSTRONG, Vice-President, in the Chair.

Messrs. Hugh Ramage, R. W. Cohen, and A. W. Nunn, were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Edward George Paul Bousfield, St. Swithin, Hendon; Albert Ernest Dunstan, 24, Lidfield Road, Stoke Newington, N.; Alfred James Hyder, 22, Gunton Road, Upper Clapton, London, N.E.; William Henry Coutts Jemmett, Tintern, Gap Road, Wimbledon; William Shepperson, Longfield, Gt. Missenden, Bucks; Charles Edmund Shaw Sherratt, 24, Argyll Road, Normacott, Staffs.

It was announced that the following changes in the Officers and Council were proposed by the Council:

As *President*: Professor J. Emerson Reynolds, Sc.D., M.D., F.R.S., *vice* Professor T. E. Thorpe, C.B., Ph.D., D.Sc., LL.D., F.R.S.

As *Vice-Presidents*: Professor Herbert McLeod, F.R.S., and Professor H. A. Miers, M.A., F.R.S., *vice* Professor G. D. Liveing, M.A., F.R.S., and Professor J. M. Thomson, LL.D., F.R.S.

As *Ordinary Members of Council*: Dr. A. W. Crossley, Professor J. J. Dobbie, M.A., D.Sc., Dr. M. O. Forster, and Mr. S. U. Pickering, M.A., F.R.S., *vice* Professor J. Norman Collie, Ph.D., F.R.S., Mr. Gowland, Mr. C. T. Heycock, M.A., F.R.S., and Dr. Messel.

Mr. F. J. M. Page, Mr. E. W. Voelcker and Mr. A. C. Chapman were appointed to audit the Society's accounts.

Mr. F. J. Lloyd was appointed to act with the Officers and Dr

Chattaway, who had been appointed by the Council, in drawing up a Report to the Council on the replies which have been received to the question as to the suggested change in the day and hour of the Ordinary Meetings.

Of the following papers, those marked * were read :

*20. "Isomeric hydrindamine mandelates and phenylchloroacethydrindamides." By F. S. Kipping and H. Hall.

Although many salts of *d-l*-hydrindamine with different optically active acids have now been submitted to fractional crystallisation (Kipping, *Trans.*, 1900, 77, 861), the resolution of the base into enantiomorphously related compounds has not yet been accomplished ; this fact, and the formation in some cases of isomeric salts which appear to be partially racemic, led the authors to try to obtain some direct evidence of the asymmetry of the base.

The fractional crystallisation of d-l-*hydrindamine* d-l-*mandelate*, $C_9H_{11}N,C_8H_8O_3$, was therefore undertaken in order to ascertain whether the two racemic or externally compensated salts,

*d*B*d*A, *l*B*l*A, and *d*B*l*A, *l*B*d*A,

could be separated, but the several fractions proved to be identical, owing possibly to the conversion of one isomeride into the other,

*d*B*d*A,*l*B*l*A ⇄ *d*B*l*A,*l*B*d*A.

From *d-l*-hydrindamine and *d-l*-phenylchloroacetyl chloride, however, two isomeric *phenylchloroacethydrindamides*, $C_6H_5{\cdot}CHCl{\cdot}CO{\cdot}NH{\cdot}C_9H_9$, melting at 150—151° and 124—125° respectively, were obtained ; in this case, the isomerides are not mutually convertible in solution, and their formation shows that the base is externally compensated.

d-l-*Hydrindamine* d-*mandelate*, prepared from the pure *d*-acid, is not resolved into different fractions when it is crystallised from alcohol ; it is therefore a partially externally compensated salt, *d*A*l*B, *d*A*d*B.

The hydrindamine salts derived from racemic mandelic acid and from pure *d*-mandelic acid respectively are indistinguishable except in optical properties ; they both melt at 139—141°, whether heated separately or mixed together in different proportions ; they have also the same, or almost the same solubility, for when a mixture of the two is fractionally crystallised, the several deposits have practically the same specific rotations.

It may be concluded, therefore, that the three optically different compounds, *d*A*d*B, *d*A*l*B, *l*A*l*B, form isomorphous mixtures, and that the salts of the active and inactive acids do not represent true partially racemic or racemic compounds.

The use of externally compensated acid chlorides for the detection of asymmetry, and of the active chlorides for the separation of enantiomorphously related compounds, is being further investigated.

*21. "Isomeric benzylhydrindamine bromocamphorsulphonates, and some salts of *d-l*-hydrindamine." By F. S. Kipping and H. Hall.

Benzylhydrindamine, $C_9H_9 \cdot NH \cdot C_7H_7$, prepared by treating *d-l*-hydrindamine with benzyl chloride, unites with α-bromocamphorsulphonic acid, forming a mixture of two isomeric salts, $C_{16}H_{17}N,C_{10}H_{14}BrO \cdot SO_3H$, which are separable by fractional crystallisation.

The more sparingly soluble "α-salt" forms transparent plates, melts at 206—207°, and has a specific rotation $[\alpha]_D = +50°$ in ethyl alcohol.

The more readily soluble "β-salt" crystallises in ill-defined prisms, melts at 186—187°, and has a specific rotation $[\alpha]_D = +51 \cdot 5°$ in ethyl alcohol; in chloroform, the specific rotation of the β-salt seems to be slightly greater than that of the isomeride.

Both salts give an optically inactive base when decomposed with barium hydroxide solution, and they both contain an acid optically identical with ordinary *d*-α-bromocamphorsulphonic acid. Since they both contain an asymmetric carbon group, as well as a nitrogen atom which is directly united with $(H),(C_9H_9),(C_7H_7)$, and with the ion of the bromo-acid, they might be regarded as salts of the two different externally compensated bases, $+C+N^V$, $-C-N^V$, and $+C-N^V$, $-C+N^V$, or they may be considered to be analogues of the isomeric hydrindamine bromocamphorsulphonates, &c., which have been recently described (Kipping, *Trans.*, 1900, **77**, 861).

d-l-*Hydrindamine* d-*camphorsulphonate*, $C_9H_{11}N,C_{10}H_{15}O \cdot SO_3H$, prepared from the base and Reychler's camphorsulphonic acid, like the salt obtained with *d*-camphor-π-sulphonic acid, is not resolved into isomerides on fractional crytallisation; it forms long prisms melting at 165—166°, and is very readily soluble in water.

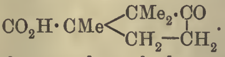
d-l-*Hydrindamine* d-*hydroxy*-cis-π-*camphanate*, $C_9H_{11}N,C_{10}H_{14}O_5$, unlike the corresponding salt of *l-cis*-π-camphanic acid, also remains homogeneous on fractional crystallisation; it forms transparent prisms $(+\frac{1}{2}H_2O)$ melting at 202—203°.

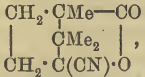
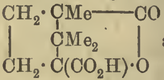
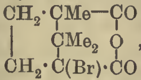
*22. "Constitution of bromocamphoric anhydride and camphanic acid." By A. Lapworth and W. H. Lenton.

The fact that ordinary bromocamphoric anhydride on treatment with alkalis is in part converted into lauronolic acid by loss of hydrogen bromide and carbon dioxide has led to the view that the bromine atom is in the β-position with regard to one of the carboxyl groups (Aschan, *Ber.*, 1894, **27**, 2112), as it is with β-bromo-acids that this property is almost exclusively associated.

In the belief that the behaviour of the anhydride in this respect is misleading, the authors have made numerous experiments which have resulted in the following observations.

Camphanic acid, on treatment with phosphorus pentabromide, is reconverted into bromocamphoric anhydride, showing that the lactonic oxygen atom occupies the position of the bromine atom in the anhydride.

It is difficult to oxidise camphanic acid with any but powerful agents, and when attacked it is usually converted into camphoronic acid or its decomposition products. When its amide, however, is warmed with phosphorus chlorides it is converted into the nitrile, and this, on treatment with alkalis, is at once resolved into hydrogen cyanide and camphononic acid, which, apart from all views as to the constitution of camphor, must have the structure  $\mathrm{CO_2H\cdot CMe}\left<\begin{array}{l}\mathrm{CMe_2\cdot CO}\\ \mathrm{CH_2-CH_2}\end{array}\right.$.

Camphanonitrile is therefore the lactone of an α-hydroxynitrilic acid, namely,  $\begin{array}{l}\mathrm{CH_2\cdot CMe-CO}\\ \mathrm{\quad\;\; CMe_2}\\ \mathrm{CH_2\cdot C(CN)\cdot O}\end{array}$, which would decompose on treatment with alkalis in the above manner. Camphanic acid and bromocamphoric anhydride are therefore represented by the formulæ suggested by Bredt, namely,  $\begin{array}{l}\mathrm{CH_2\cdot CMe-\!\!-CO}\\ \mathrm{\quad\;\; CMe_2}\\ \mathrm{CH_2\cdot C(CO_2H)\cdot O}\end{array}$ and  $\begin{array}{l}\mathrm{CH_2\cdot CMe-CO}\\ \mathrm{\quad\;\; CMe_2\;\; O}\\ \mathrm{CH_2\cdot C(Br)\cdot CO}\end{array}$, and the formation, from them, of lauronolic acid has not the significance which has been attached to it.

*23. "The action of acetylchloro- and acetylbromo-aminobenzenes on amines and phenylhydrazine." By F. D. Chattaway and K. J. P. Orton.

In studying the action of nitrogen chlorides and nitrogen bromides on amines and phenylhydrazine, the authors have used the acetylchloro- and acetylbromo-amino-2 : 4-dichlorobenzene recently prepared by them, as these substances are readily obtained pure. The operations have generally been carried out in chloroform solution, avoiding as far as possible the presence of water.

The reaction with the aliphatic amines is represented by the equation $\mathrm{R\cdot NH_2 + C_6H_3Cl_2\cdot NClAc = R\cdot NHCl + C_6H_3Cl_2\cdot NHAc}$. The chloroamino-derivatives thus formed can be isolated.

The initial reaction with the aromatic amines (anilines and toluidines) is similar. The halogen, however, immediately wanders from the nitrogen into the para- and ortho-positions if these are unoccupied When the hydrogen atoms in the positions 2, 4, and 6 are already substituted, no such intramolecular transformation can take place, but the halogen amino-derivatives of such anilines (as *s*-trichloroaniline) are very unstable, and decompose, yielding substituted azobenzenes. The azo-formation takes place to some extent when acetylchloroaminobenzenes react with the less substituted anilines and toluidines.

Two reactions take place between phenylhydrazine and halogen amino-compounds. The one, when phenylhydrazine is in excess, is represented by the equation $4C_6H_5{\cdot}NH{\cdot}NH_2 + 2(:NX) = C_6H_5N_3 + C_6H_5NH_2 + 2C_6H_5{\cdot}NH{\cdot}NH_2{\cdot}HCl + 2(:NH)$; the other, when the halogen amino-compound is in excess, by the equation $C_6H_5NH{\cdot}NH_2 + 3(:NX) = C_6H_5X + N_2 + X_2 + 3(:NH)$.

In the authors' opinion, the formation of these substances is not a result of oxidation, but depends on the intermediate formation of halogen hydrazino-derivatives.

The following hitherto undescribed substances have been prepared: *Aceto-4-chloromethylaniline*, $C_6H_4Cl{\cdot}NCH_3{\cdot}COCH_3$, m. p. 92°, white plates from petroleum; *o-chloromethylaniline*, $C_6H_4Cl{\cdot}NH{\cdot}CH_3$, a colourless oil, b. p. 218° (760 mm.); *2-chloro-5-bromoacetanilide*, $C_6H_3ClBr{\cdot}NH{\cdot}COCH_3$, needles, m. p. 141°; *3-bromo-4-chloroacetanilide*, $C_6H_3ClBr{\cdot}NH{\cdot}COCH_3$, rhombs, m. p. 130°; 2 : 4 : 6, 2′ : 4′ : 6′-*hexachloroazobenzene*, $C_6H_2Cl_3{\cdot}N:N{\cdot}C_6H_2Cl_3$, dark red needles, m. p. 188°.

*24. "The preparation of orthochloroaniline." By F. D. Chattaway and K. J. P. Orton.

The authors described a convenient method of preparing orthochloroaniline by the chlorination of acetanilide.

The chlorination is effected by adding the calculated quantity of a strong solution of bleaching powder to a solution of acetanilide (1 part) in glacial acetic acid (3 to 4 parts). Orthochloroacetanilide, which forms from 5 to 8 per cent. of the product, is partly separated from the para-derivative by fractional crystallisation from alcohol. The *o*-chloroaniline is finally freed from *p*-chloroaniline by distilling in steam from sulphuric acid.

*25. "The bacterial oxidation of formates by nitrates." By W. C. C. Pakes and W. H. Jollyman.

In previous communications the authors have described the actions of a group of bacteria upon solutions containing sodium formate, and of another group upon solutions containing sodium or potassium nitrate.

Many of the bacteria which decompose the formate are also found to decompose the nitrate, such, for instance, as the *B. coli communis*, *B. enteritidis* of Gärtner, and the *Pneumobacillus* of Friedländer, each of which converts formic acid into carbon dioxide and hydrogen, and reduces nitric to nitrous acid.

If any of these bacteria be cultivated in a medium containing both formate and nitrate (1 per cent. of each), it will be found that no gas will be evolved. After the lapse of several days, the fluid will be found to contain sodium hydrogen carbonate and sodium nitrite. When the medium contains an excess of sodium formate as compared with the sodium nitrate, gas is evolved which, upon analysis, proves to consist of carbon dioxide and nitrogen.

When the same bacteria are cultivated in media containing *d*-glucose and sodium nitrate, a similar effect is produced, gas is evolved which consists of carbon dioxide and nitrogen, or carbon dioxide, nitrogen and hydrogen, the latter being found if the sugar is in excess as compared with the nitrate.

The authors have not yet been able to determine whether a similar result would be obtained when the organism used did not act upon both, but they have succeeded in showing that the *B. pyocyaneus* (which does not decompose formate) acts in a medium containing both salts almost as if the formate were absent; they have not as yet been able to find a bacterium which decomposes formate, but which does not reduce nitrates.

26. "Condensation of phenols with esters of the acetylene series. Part IV. Benzo-γ-pyrone and its homologues." By S. Ruhemann and H. W. Bausor, B.A.

Ruhemann and Stapleton have shown (*Trans.*, 1900, 77, 1184) that phenoxyfumaric acid under the influence of concentrated sulphuric acid condenses to benzo-γ-pyronemonocarboxylic acid, which, on distillation, yields benzo-γ-pyrone. The authors of the present paper have applied these reactions to the cresoxyfumaric acids, and thus obtained the corresponding tolu-γ-pyronecarboxylic acids and tolu-γ-pyrones.

27. "The influence of solvents on the rotation of optically active compounds. II. The influence of isobutyl alcohol and secondary octyl alcohol (methylhexylcarbinol) on the rotation of ethyl tartrate. By T. S. Patterson.

In continuation of work already published (*Trans.*, 1901, 79, 167), experiments were described whose object was to determine the influence of *iso*butyl and octyl alcohols as solvents upon the rotation of ethyl tartrate. It was found that both liquids lower the specific rotation of the dissolved active substance, the latter having the greater effect. In both cases, concentrations of distinct minimum rotation occur. This phenomenon was briefly discussed.

It was also shown that ethyl tartrate in *iso*butyl alcohol has a molecular-solution-volume greater than that in *n*-propyl alcohol, but less than that in octyl alcohol, which is in agreement with the generalisation deduced from the results of the former investigation.

28. "Influence of a heterocyclic group on optical rotation; the ethyl and methyl salts of dipyromucyltartaric acid." By P. F. Frankland and F. W. Aston.

The authors have investigated the influence on optical rotation of the heterocyclic furfurane group by preparing diethyl dipyromucyltartrate and determining its rotation. The molecular rotation, $[M]_D^{20} = -321{\cdot}44°$, $[M]_D^{99{\cdot}5} = -266{\cdot}54°$, is, at 20°, intermediate between that of diethyl di-*m*-toluyltartrate ($[M]_D^{20} = -306{\cdot}3°$) and diethyl di-*p*-toluyltartrate ($[M]_D^{20} = -484{\cdot}4°$), and at 100° intermediate between that of diethyl dibenzoyltartrate ($[M]_D^{100} = -251{\cdot}6°$) and diethyl di-*m*-toluyltartrate ($[M]_D^{100} = -281{\cdot}7°$). Thus the influence of the pyromucyl radicle is similar to that of the aromatic acid, but unlike that of the fatty acid radicles, the derivatives of ethyl tartrate with two equivalents of the former being strongly lævorotatory whilst those with the latter are more strongly dextrorotatory than ethyl tartrate itself. The pyromucyl derivative again resembles the corresponding aromatic derivatives in having its lævorotation diminished by rise of temperature, whilst the corresponding derivatives with fatty acid radicles have their dextrorotation increased under the same circumstances.

The authors also described a novel method of continuous automatic esterification which has been advantageously employed by them in the preparation of methyl and ethyl tartrates.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on Wednesday, March 27th, 1901, the day preceding that fixed for the Annual General Meeting. Further particulars will shortly be announced.

At the next meeting, on Thursday, March 7th, the following papers will be communicated:

"Nomenclature of the acid esters of unsymmetrical dibasic acids." By J. J. Sudborough.

"Additive compounds of α- and β-naphthylamine with trinitrobenzene derivatives." By J. J. Sudborough.

"Acetylation of arylamines." By J. J. Sudborough.

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PROCEEDINGS

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CHEMICAL SOCIETY.

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Vol. 17. No. 234.

March 7th, 1901. Dr. PERKIN, F.R.S., Vice-President, in the Chair.

Messrs. T. H. Page and James Moir were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Ernest Clark, 9, Polygon Avenue, Stockport Road, Manchester; Thomas Kennedy Cockburn, 26, Elm Street, Whiteinch, Glasgow; Eustace Coddington, 131, St. James' Road, Upper Tooting, London, S.W.; Hugh Edward Ellis, 18, Belmont Road, Aberdeen; John Vargas Eyre, 26, Bridge Road West, Battersea Park, S.W.; Francis Robert Henley, Watford, Rugby; Charles Edward Kenneth Mees, 33, St. Saviour's Road, Croydon; Arthur Peacock, Smithies Bridge House, Heckmondwike, Yorks.; William Hammond Robinson, The Limes, Painswick Road, Cheltenham; Henry Ewing Smith, 22, City Road, London, E.C.; William Henry Taylor, 19, Shafton Road, Victoria Park Road, N.E.

Of the following papers, those marked * were read:

*29. "Nomenclature of the acid esters of unsymmetrical dicarboxylic acids." By J. J. Sudborough.

After mentioning the systems adopted by Brühl, Wegscheider, and Anschütz, the author suggested the following nomenclature.

Of the two isomeric monoalkyl esters of an unsymmetrical dibasic acid, that ester be termed the α-compound which has the higher esterification constant, and the other with the lower constant the β-compound.

The advantages of this system are: (1) similarly constituted esters receive similar names; (2) in the case of many of the simpler acids, the substituent which produces the want of symmetry is in the α-position to the alkylated carboxylic group; (3) ease with which the two esters may be identified.

*30. "Additive compounds of α- and β-naphthylamine with trinitrobenzene derivatives." By J. J. Sudborough.

The red needles which were obtained when α-naphthylamine trinitrobenzoate was boiled with alcohol (*Trans.*, 1899, **75**, 588) are an additive compound of trinitrobenzene with α-naphthylamine. A number of other similar compounds have been obtained; all are red or reddish-purple in colour, are remarkably stable, may be crystallised from glacial acetic acid, and are only slowly decomposed by cold dilute hydrochloric acid; they are also stable when exposed to the air, and in these properties differ from the additive compounds of trinitrobenzene, with aniline, toluidine, &c., described by Hepp (*Annalen*, 1882, **215**, 344).

The following are the compounds which have been prepared: *α-naphthylamine trinitrobenzene*, m. p. 214°; *β-naphthylamine trinitrobenzene*, m. p. 162°; *α-naphthylamine trinitrotoluene*, m. p. 141·5°, the *β-isomeride*, m. p. 113·5°; *α-naphthylamine picramide*, m. p. 203°, and the *β-isomeride*, m. p. 161·5°; *α-naphthylamine ethyltrinitrobenzoate*, m. p. 135°, and the *β-isomeride*, m. p. 126°; *α-naphthylamine ethylpicrate*, m. p. 79·5°; and *α-naphthylamine methylpicrate*, m. p. 75°.

With the object of determining the constitution of these compounds, the action of acetic anhydride and of alcoholic potash on them has been studied; it was thought probable that these reagents might indicate the presence of a hydroxyl group.

α-Naphthylamine trinitrobenzene and acetic anhydride warmed for a few minutes yield a monoacetyl derivative, which crystallises from benzene in sulphur-yellow needles melting at 140·5°. The compound has the acetyl group attached to nitrogen, as the same substance may be obtained by the direct union of trinitrobenzene and α-acetnaphthalide, and as it yields α-acetnaphthalide on treatment with methyl alcoholic potash. Several similar acetyl derivatives have been prepared.

A methyl alcoholic solution of potassium hydroxide decomposes the red compounds, yielding the potassium derivative of trinitrobenzene described by Lobry de Bruyn.

*31. "Acetylation of arylamines." By J. J. Sudborough.

According to Ulffers and von Janson (*Ber.*, 1894, 27, 93), acid ortho-substituents retard the introduction of an acetyl group into a primary arylamine, but at the same time facilitate the introduction of a second acetyl group. Quantitative experiments have been made by boiling aniline, *o*-toluidine, *p*-toluidine, pseudocumidine, α- and β-naphthylamines with acetic anhydride for an hour and determining the percentage of the arylamine converted into mono- or di-acetyl compounds. The results indicate that a methyl or phenylene group in an ortho-position facilitates diacetylation. All *o*-substituents, whether of a positive or negative character, thus appear to have the property of accelerating the formation of diacetyl derivatives of primary arylamines.

The following new compounds were described: *Diacetyl-pseudocumidine*, $C_6H_2Me_3{\cdot}NAc_2$ [$Me_3 : N = 1:2:4:5$], well developed, transparent prisms melting at 69·5°; *diacetyl-α-naphthylamine*, $C_{10}H_7NAc_2$, colourless, hard prisms melting at 130°; *diacetyl-β-naphthylamine*, colourless plates melting at 66·5°; and *diacetyl*-2:6-*dibromaniline*, large prisms melting at 100°. Most of these diacetyl derivatives crystallise remarkably well, and are readily soluble in the ordinary organic solvents.

*32. "Formation of amides from aldehydes." By R. H. Pickard and W. Carter.

When an aldehyde is oxidised with ammonium persulphate in the presence of lime, a 30—40 per cent. yield of the amide of the corresponding acid is obtained. The greater portion of the remainder of the aldehyde can be recovered unchanged, and by further oxidation the yield of amide can be increased to 70 per cent. of the weight of aldehyde taken. Substituted amides can be obtained by using potassium persulphate and an amine.

*33. "A method of isolating maltose when mixed with glucose." By A. C. Hill, M.A.

This method is, essentially, one of removal of the glucose by fermentation with *Saccharomyces Marxianus*, a yeast observed by Hansen in 1888 as not fermenting maltose. It includes also certain details of procedure, which have been found to facilitate, even if they are not necessary to, an easy crystallisation of the maltose after the fermentation is over, and reduce to a minimum such adventitious impurities as the bye-products of fermentation and the oxidation products of the sugars.

A pure culture of the yeast, which has been grown in a glucose broth, is washed repeatedly with sterilised tap water, making use of a centrifuge, and is then added to a sterilised solution of the sugars which it is desired to ferment. The solution, which may be in an ordinary flask closed by a cotton wool plug, should not contain much more than 10 per cent. of sugar and should be made up in part with sterilised tap water.

The fermentation is conducted at 25—29° and proceeds slowly in the absence of proteid and without any notable multiplication of the yeast cells. When the evolution of carbon dioxide has nearly ceased, the flask is heated for a minute or so at 100° in the autoclave, and then its contents are freed from cells by filtration through a porous funnel. Alcohol is added to the solution to one-third of its volume and the whole evaporated down in a current of carbon dioxide to a thick syrup under diminished pressure; if necessary, more alcohol is added during the evaporation so that the temperature does not rise above 60°. The rest of the process resembles that usually employed in the recrystallisation of maltose from 80 to 85 per cent. ethyl alcohol and results in the separation of the maltose quite white at the first crystallisation.

*34. "The vapour pressure of aqueous ammonia solution." By E. P. Perman, D.Sc.

The vapour pressure of aqueous ammonia solutions of concentrations varying from nothing to 35 per cent. has been found by a statical method; the temperatures ranged from 0° to 60°. The curves showing the variation of pressure with concentration at various temperatures are found to be approximately represented by the equation $p(100-c)=ac+bc^2$; a and b are constants, c is the concentration of the ammonia in the solution.

The equation may be put in the form $p(100-c)=c.k$, when $k=a+bc$ and is the reciprocal of the solubility coefficient. The variation of pressure with temperature (the concentration remaining constant) is expressed with fair accuracy by the equation $\log.p=\alpha+\beta t+\gamma t^2$, α, β, and γ being constants, of which γ is always negative.

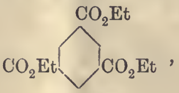
The constant β is found to have the same value as the corresponding constant found in the expression $\log.b=\alpha'+\beta' t$ for the *rate of escape* of ammonia from aqueous solution (*Trans.*, 1898, **73**, 511).

*35. "The influence of sodium sulphate on the vapour pressure of aqueous ammonia solution." By E. P. Perman, D.Sc.

The author has determined the vapour pressures of ammonia solutions containing sodium sulphate in solution at temperatures varying from 26° to 47° and has compared them with corresponding solutions of ammonia without sodium sulphate. The curves show no break at 33°, nor do they diverge more than those for ammonia solution. Hence it seems probable that the sodium sulphate does not exist as a hydrate in solution.

36. "Formation of aromatic compounds from ethyl glutaconate and its derivatives. The reduction of trimesic acid and the conversion of tetrahydrotrimesic acid into tetrahydroisophthalic acid." By W. T. Lawrence and W. H. Perkin, jun.

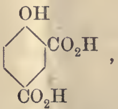
In experimenting with the sodium compound of ethyl sodio-dicarboxyglutaconate, $\mathrm{(CO_2Et)_2CNa{\cdot}CH{:}C(CO_2Et)_2}$, the authors have found that this compound, when heated with alcohol at 150°, is decomposed with formation of a large yield of *ethyl trimesate*,



and further, that methyl sodiodicarboxyglutaconate under the same conditions is converted into *methyl trimesate*.

When the sodium compound of ethyl glutaconate, $\mathrm{CO_2Et{\cdot}CHNa{\cdot}CH{:}CH{\cdot}CO_2Et}$, is heated with alcohol at 150°, it is also decomposed, but in a different manner, and the product on hydrolysis yields *hydroxy*iso*phthalic acid.*

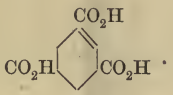
This acid was identified by analysis, and by conversion into the methyl ester (m. p. 94°) and into the ethyl ester (m. p. 52°), and it is thus identical with the hydroxy*iso*phthalic acid,



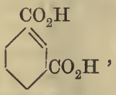
which Kupferberg (*J. prakt. Chem.*, 1877, [ii], **16**, 428) obtained by heating sodium salicylate in a current of carbon dioxide.

When ethyl methylglutaconate, $\mathrm{CO_2Et{\cdot}CHMe{\cdot}CH{:}CH{\cdot}CO_2Et}$, is heated with sodium ethylate and alcohol at 140°, it yields a solid ester melting at 96° which, on hydrolysis, is converted into an acid very sparingly soluble in water and melting at 216°; these substances are at present under investigation. The authors have also found that when the sodium compound of ethyl malonate is digested with ethyl trichloroacetate there is formed, besides the sodium compound of ethyl dicarboxyglutaconate (Ruhemann, *Ber.*, 1896, **29**, 1017), an ester which on hydrolysis and elimination of carbon dioxide, yields aconitic acid. This ester, which is the normal product of the reaction, therefore must have the formula $(CO_2Et)_2CH{\cdot}C(CO_2Et){:}C(CO_2Et)_2$.

When trimesic acid, dissolved in sodium carbonate, is treated with sodium amalgam, it is readily reduced with formation of a mixture of acids, which are evidently stereoisomeric modifications of tetrahydrotrimesic acid,



One of these acids has been isolated in a pure condition, it melts at about 210° and is very sparingly soluble in dry ether. When digested with acetic anhydride it yields a resinous double anhydride of trimesic acid and acetic acid, which on distillation loses carbon dioxide, with formation of the anhydride of tetrahydro*iso*phthalic acid. On treatment with potash this anhydride yields tetrahydro*iso*phthalic acid as a colourless crystalline substance sparingly soluble in water and melting at 244°; from its method of formation it must have the formula,

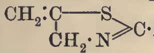


and is the first tetrahydro*iso*phthalic acid which has so far been prepared. The authors are continuing their investigation on the action of sodium ethylate on the derivatives of glutaconic acid and other similarly constituted acids.

37. "Optical activity of certain ethers and esters." By P. A. Guye.

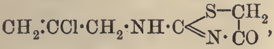
The author has confirmed the results of Tschugaeff's observations, quoted by McCrae and Patterson (Trans., 1900, **77**, 1096) that the optical rotation of compounds containing the phenacetyl group resembles more closely that of compounds containing the acetyl or the chloroacetyl group, than that of compounds containing the toluyl group, although the mass of the phenacetyl group is more nearly that of the toluyl group than of either of the other groups named. The examination of a number of compounds of amyl (phenyl-amyl oxide· benzyl-amyl oxide, and various amyl esters) has led the author to an analogous conclusion. It is, however, only one case of a more general conclusion already drawn by him, namely, that when substitutions of chains or groups of elements are effected in an asymmetric carbon compound, sufficiently far from the asymmetric carbon atom, the optical rotation is only slightly affected.

38. "Halogen-substituted thiosinamines." By A. E. Dixon, M.D.

From the researches of Gabriel and others, as well as from his own previous work, the author thought it not unlikely that the 'chlorallylthiourea' of Henry (*Ber.*, 5, 188), obtained from β-chloroallylthiocarbimide and ammonia, might really be the hydrochloride of a ring-compound,  $\begin{matrix}CH_2{:}C—S\\ CH_2{\cdot}N\end{matrix}\!\!>\!C{\cdot}NH_2$; to test this, he has prepared the thiocarbimide, and examined a number of its compounds with bases.

Contrary to anticipation, the addition products so obtained are not closed chain saline derivatives; no formation of haloid acid occurs, but the constituents unite directly, yielding the corresponding halogen-substituted thiocarbamides.

β-Chloroallylthiocarbimide, $CH_2{:}CCl{\cdot}CH_2{\cdot}NCS$, is a colourless, highly refracting oil boiling at about 182°; it is slightly soluble in water, has a very pungent odour, and readily blisters the skin.

With ammonia it yields Henry's β-chloroallylthiourea; prisms, melting at 93·5—94·5° (corr.); Henry gives 90—91°. This substance is moderately soluble in water, and easily so in alcohol; the latter solution, if moderately dilute, gives no precipitate with silver nitrate, but is freely desulphurised by warming with alkaline lead tartrate. Chloroallylthiourea undergoes no isomeric change if boiled in aqueous solution; when fused with monochloracetic acid, it yields the hydrochloride of *β-chloroallylthiohydantoin*,  $CH_2{:}CCl{\cdot}CH_2{\cdot}NH{\cdot}C\!<\!\!\begin{matrix}S—CH_2\\ N{\cdot}CO\end{matrix}$, white prisms, which begin to decompose at about 170°, and lose the combined acid on recrystallisation from water. The free thiohydantoin is deposited from water in leaves, and from alcohol in prisms, both forms melting at 149°; when hydrolysed by boiling with dilute alkali, thioglycollic acid is produced.

ab-*Chloroallylphenylthiocarbamide*, $CH_2{:}CCl{\cdot}CH_2{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_5$, prepared from the thiocarbimide and aniline, is deposited from benzene in plates, m. p. 91—92°. When desulphurised by silver nitrate it gives rise to the corresponding ab-*chloroallylphenylcarbamide*, as slender prisms, m. p. 151—152°.

ab-*Chloroallylorthotolylthiocarbamide* separates from weak alcohol in prisms, m. p. 84—85°.

ab-*Chloroallylbenzylthiocarbamide* crystallises from a mixture of benzene and light petroleum in very brilliant prisms, m. p. 69°. Unlike the preceding thiocarbamides, it is not desulphurised when boiled with alkaline lead tartrate.

Piperidine yields *chloroallylpiperidylthiourea* in transparent quadrangular plates, m. p. 146·5—147·5°.

n-*Chloroallyl-v-benzylphenylthiourea*, $C_3H_4Cl\cdot N\colon C(SH)\cdot NBzPh$, is deposited from light petroleum in needles, m. p. 77—78°.

β-Chloroallylthiocarbimide, dissolved in chloroform, absorbs bromine, yielding *β-chloro-βγ-dibromopropylthiocarbimide*,

$$CH_2Br\cdot CClBr\cdot CH_2\cdot NCS,$$

a dense, yellowish liquid, volatile in a current of steam; it unites spontaneously with aniline, forming the hydrobromide of a ring compound, $C_3H_4BrCl{<}\substack{N\\S}{>}C\cdot NH\cdot C_6H_5$. The hydrobromide occurred as a sandy powder, m. p. 112—113°; when treated with cold alkali, hydrogen bromide was removed, but the base could not be obtained in a state fit for analysis.

With benzylamine an oily hydrobromide was produced; from this potash withdraws a molecule of hydrogen bromide, leaving the free base, $C_3H_4Br_2{<}\substack{N\\S}{>}C\cdot NH\cdot CH_2\cdot C_6H_5$, which crystallises in prisms, m. p. 107—108°, and dissolves in hydrobromic acid to re-form the oily hydrobromide.

39. "A form of tautomerism occurring amongst the thiocyanates of electro-negative radicles." By A. E. Dixon, M.D.

Some years ago (*Trans.*, 1897, **71**, 640; see also 1899, **75**, 389), the author remarked that the so-called "phosphorus trithiocyanate," $P(SCN)_3$, appeared to possess thiocarbimidic as well as thiocyanic properties, and subsequent investigation tends to show that this power to function in both capacities is also manifested by the products obtainable from metallic thiocyanates and the chlorides of a number of electro-negative mineral elements and compound radicles.

The chlorides, dissolved in suitable anhydrous solvents, were caused to interact with excess of lead or other metallic thiocyanate, if possible, until the chlorine was completely eliminated as metallic chloride; the solid residue was then filtered off, and the filtrate treated with a base such as aniline. Precipitates were thus obtained, which gave the desulphurisation tests with lead and silver salts, characteristic of thiocarbamides, and were usually hydrolysed by contact with water so as to afford the substituted thiourea corresponding to the base used.

Unfortunately, no efficient method has yet been found for purifying these precipitates, which are rarely free from more or less contamination with basic thiocyanate.

"Phosphorus trithiocyanate," $P(SCN)_3$, gave with aniline a yellow solid insoluble in cold water, but decomposed when boiled with water into phenylthiourea and an acid of phosphorus; this substance is probably phosphorus triphenyltrithiourea, $P(NH\cdot CS\cdot NH\cdot C_6H_5)_3$. With *o*-toluidine a yellow powder melting between 81° and 83° was obtained; it appears to be the corresponding tolyl derivative nearly pure. Both these compounds are very freely soluble in alcohol and acetone, but nearly insoluble in benzene, chloroform, and light petroleum.

"Phosphoryl trithiocyanate," $PO(SCN)_3$, obtained in solution by boiling phosphorus oxychloride in dry cumene with lead thiocyanate, gave with silver and lead salts the usual thiocarbimidic reactions; and united spontaneously with aniline, *o*-toluidine and dry ammonia.

The *aniline* compound was a pale yellow powder melting at about 111—112°, freely soluble in alcohol, ethyl acetate, acetone, glacial acetic acid, and nitrobenzene; insoluble, or nearly so, in chloroform, ether, carbon disulphide, benzene and light petroleum. It was nearly insoluble in cold water, but dissolved gradually on boiling; the solution contained phosphoric and thiocyanic acids, and on cooling, gave a crystalline deposit of phenylthiourea. The latter appears to be formed by hydrolysis of phosphoryltriphenyltrithiocarbamide: $PO(NH\cdot CS\cdot NH\cdot C_6H_5)_3 + 3H_2O = H_3PO_4 + 3CSN_2H_3\cdot C_6H_5$.

Orthotoluidine gave a tenacious oil, hardening presently to a resin-like solid; its properties resembled those of the phenylic homologue but the substance could not be obtained in a pure condition.

Dry *ammonia* gas yielded a pale yellow granular solid, melting, imperfectly, below 60°, readily soluble in water, and containing a very appreciable quantity of ammonium thiocyanate. The solution in cold water gave with excess of ammonia, followed by magnesia mixture, scarcely any precipitate. But this solution, if previously boiled and allowed to cool, then reacted freely with the above test; consequently it is inferred that the phosphoric acid does not exist ready formed in the solution, but originates through the hydrolysis of the phosphoryltrithiourea, $PO(CSN_2H_3)_3$.

The "thionyl thiocyanate" of McMurtry (*Trans.*, 1889, **55**, 48) differs in physical and chemical characters from all the known electronegative thiocyanates; it is suggested that this compound, of which the thiocyanic properties are very feebly marked, whilst it gives decided thiocarbimidic reactions, is probably a polymeric form, $[SO(NCS)_2]_n$.

Carbonyl chloride, in toluene, reacted with lead thiocyanate on standing; the dissolved sulphuretted product (which was freely desulphurised by lead and silver salts) combined at once with aniline, yielding in small quantity a substance melting at about 174° and possessing the characters of a thiocarbamide.

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Metropole, on Wednesday, March 27th, at half-past six for seven o'clock.

The price of the tickets is one guinea each including wine.

Fellows are particularly requested to give the Secretaries early notice of their intention to be present.

Tickets will be forwarded to Fellows on receipt of a remittance for the number of tickets required, addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on Thursday, March 28th, at three o'clock in the afternoon.

At the next meeting, on Thursday, March 21st, the following papers will be communicated:

"Researches on morphine. Part II." By S. B. Schryver and F. H. Lees.

"The constitution of pilocarpine. Part II." By H. A. D. Jowett.

"Note on the latent heats of evaporation of liquids." By H. Crompton.

"Action of dry silver oxide and ethyl iodide on benzoylacetic ester, desoxybenzoin, and benzyl cyanide." By G. D. Lander.

"Alkylation of acylarylamines." By G. D. Lander.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 10/4/1901

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 235.

March 21st, 1901. Professor THORPE, C.B., F.R.S., President, in the Chair.

Messrs. G. D. Lander, H. W. Kinnersley, and E. F. Linstead were formally admitted Fellows of the Society.

The following certificates were read for the first time:—William Henry Duckworth, 87, New Bank Road, Blackburn; Samuel Philip Eastick, 25, Woodville Road, Ealing; Ernest Alfred Lewis, 310, Dudley Road, Birmingham; Alexander McKenzie, Jenner Institute, S.W.; Edgar Neuman, 10, Randolph Crescent, Maida Vale, London; William Oldershaw, Market Place, Nottingham; Samuel Slefrig, 18, Waterloo Road, Shepton Mallet, Som.; James Smith, 14, Mersey Road, Aigburth, Liverpool.

REPLY TO THE ADDRESS TO THE KING.

The SECRETARY read the following reply which His Majesty the King has been graciously pleased to cause to be made to the Address of the President, Council, and Fellows of the Society.

MARLBOROUGH HOUSE,
PALL MALL, S.W.
23rd February, 1901.

The Private Secretary is commanded by the King to thank the President, Council, and Fellows of the Chemical Society, for the kind expression of their sympathy with His Majesty, on the occasion of the lamented death of Her late Majesty the Queen, and for the loyal and dutiful sentiments conveyed in their Address to the King.

DAY AND HOUR OF MEETING.

The following is the report of the Committee appointed by the Council to examine the cards returned by Fellows in reply to the question as to the suggested change in the Day and Hour of the Ordinary Meetings to Wednesday, at 5.30 p.m. :—

"Nineteen hundred cards were issued to Fellows, and 1000 answers were returned. Of these, 581 were unreservedly in favour of the change, namely, 256 London Fellows, and 325 Country Fellows. 118 Fellows, whilst not voting unreservedly for the change, said they offered no objection to it. 172 Fellows were unreservedly opposed to the change. Of the 129 Fellows remaining, 85 expressed no objection to the change of day, but offered suggestions as to change of hour. 3 suggested meeting at 3, 1 at 4, 1 at 4.30, 12 at 5, 12 at 6, 9 at 6.30, 10 at 7, 5 at 7.30, 15 at 8, and 2 at 8.30. 11 suggested a later hour than 5.30 without particularising it, and 4 alternately 5.30 and 8. 24 Fellows suggested meeting on some other day than Wednesday or Thursday, namely, 2 on Monday at 5.30, 1 on Tuesday at 8, 14 on Friday, 10 of whom preferred 5.30; of the remaining 4, 2 indicated no preference as to hour, 1 suggested 8, and 1 suggested 8.30. 7 Fellows suggested various hours on Saturday afternoon or evening. 16 Fellows preferred Thursday, but suggested some other hour than 8, 11 suggested 5.30, 1 preferred 6, and 3 preferred 7. 1 suggested 8.30. 4 Fellows deprecated the change on the ground that it clashed with the present arrangements of the Society of Public Analysts.

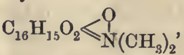
"Analysing the replies of those Fellows who have contributed papers to the Society, 266 of whom have responded, 188 have voted for the change, and 78 against it."

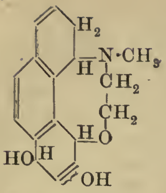
Of the following papers, those marked * were read:

*40. "Researches on Morphine. Part II." By S. B. Schryver and F. H. Lees.

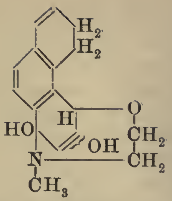
The authors have shown (*Trans.*, 1900, 77, 1024) that bromomorphide, $C_{17}H_{18}O_2NBr$, is decomposed by water in accordance with the equation $C_{17}H_{18}O_2NBr + H_2O = C_{17}H_{19}O_3N,HBr$, and from the reaction product a new base, isomeric with morphine and designated iso*morphine*, was isolated and described. The authors have since isolated from the product of the above reaction another new base, *β*-iso*morphine*, $C_{17}H_{19}O_3N$, which is formed only in relatively small amount. It crystallises from alcohol in double pyramids of the formula

$2C_{17}H_{19}O_3N,C_2H_6O$, which, after drying at 120° melt at 182°, and for which $[\alpha]^{17°} = -216{\cdot}2°$. Chloromorphide, when decomposed by water, also yields *β-iso*morphine, together with another base which has not yet been further examined. In view of the non-narcotic action of *iso*morphine as compared with morphine, experiments were carried out to determine the chemical relationship between the two isomerides. *iso*Morphine yields a *diacetyl* iso*morphine methiodide*, $C_{17}H_{17}(O{\cdot}CH_3CO)_2ONCH_3I$, as needles melting at 242° with decomposition. Phosphorus tribromide reacts with *iso*morphine, giving bromomorphide (m. p. 170°) identical with that obtained from morphine by the same reaction. Phosphorus trichloride, on the other hand, reacts with *iso*morphine, yielding no definite product, whereas chloromorphide results from the same reaction with morphine. iso*Codeine methiodide*, $C_{17}H_{18}O_2(OCH_3)NCH_3I$, forms leaflets melting at 265° with decomposition, and for it $[\alpha]^{17°}_D = -102\ 1°$. It was prepared by the three following methods: (*a*) by the action of silver sulphate and barium hydroxide on *iso*morphine methiodide, with subsequent interaction of the resulting methydroxide and methyl iodide; (*b*) by the action of excess of methyl iodide on the sodium derivative of *iso*morphine; (*c*) from codeine by the following steps: *bromocodeide*, $C_{17}H_{17}O(OCH_3)N{\cdot}Br$, prepared by the action of phosphorus tribromide on codeine, forms pearly scales melting at 162°, for which $[\alpha]^{20°}_D = +56{\cdot}7°$; iso*codeine*, $C_{17}H_{18}O_2(OCH_3)N$, from the action of water on bromocodeide, which forms needles melting at 144°, for which $[\alpha]^{13°}_D = -169°$. The methiodide was then readily prepared from *iso*codeine.

The formation of *iso*codeine methiodide by the above methods confirms the phenolbetaine constitution,  $C_{16}H_{15}O_2\!<\!\begin{matrix}O\\ |\\ N(CH_3)_2\end{matrix}$, for *iso*morphine methydroxide, which was provisionally assigned to this substance by the authors in their previous paper. Sodium hydroxide reacts with *iso*codeine methiodide, yielding the base *methi*-iso*morphimethin*, $C_{16}H_{14}O_2(OCH_3){\cdot}N(CH_3)_2$, which forms tables melting at 167°, and having $[\alpha]^{20°}_D = +64{\cdot}6°$. *Methi*-iso*morphimethin methiodide*, $C_{16}H_{14}O_2(OCH_3){\cdot}N(CH_3)_3I$, forms needles melting at 265°, and for which $[\alpha]^{17°}_D = +34{\cdot}7°$. *Methi*-iso*morphimethin methydroxide* is split up by the action of heat and yields morphenol methyl ether, $C_{15}H_{10}O_2$, m. p. 65°, which is identical with the phenol obtained by Knorr (*Ber.*, 1889, **22**, 183) from codeine methiodide, the morphine derivative, by analogous reactions to the above. These results indicate the presence in *iso*morphine of exactly the same groups as occur in morphine, and the authors suggest that the relationship between these two bases is, in all probability, similar to that represented by the two following formulæ:



Morphine (Knorr).



*iso*Morphine.

The different physiological behaviour of morphine and *iso*morphine was treated of from the standpoint of Ehrlich's view.

*41. "The constitution of pilocarpine. Part II." By H. A. D. Jowett, D.Sc.

When bromine acts on *iso*pilocarpine in acetic acid solution, dibromo*iso*pilocarpine perbromide is formed as the chief product of the reaction, but small quantities of monobromo*iso*pilocarpine and *iso*pilocarpinic acid are also produced. *Dibromo*iso*pilocarpine perbromide*, $C_{11}H_{14}O_2N_2Br_2 \cdot HBr_3$, crystallises in needles melting at 165°. Treated with ammonia, *dibromo*iso*pilocarpine*, $C_{11}H_{14}O_2N_2Br_2$, is formed, crystallising in rectangular prisms melting at 135°. It is optically inactive and is only feebly basic, being precipitated from its solution in strong acids by water; it does not react with methyl iodide. On reduction, it is converted into *iso*pilocarpine. *Monobromo*iso*pilocarpine*, $C_{11}H_{15}O_2N_2Br$, forms needles melting at 164°. Iso*pilocarpinic acid*, $C_{11}H_{16}O_4N_2$, was only obtained as an oil. It yields a microcrystalline barium salt, $(C_{11}H_{15}O_4N_2)_2Ba$, and is therefore monobasic.

Dibromo*iso*pilocarpine, on oxidation with permanganate, yields hydrobromic acid, ammonia, methylamine, a new acid termed *pilopinic acid*, $C_8H_{11}O_4N$, and the acid, $C_7H_{10}O_4$, previously described, and which is now called pilopic acid.

Pilopinic acid, $C_8H_{11}O_4N$, is crystallised with difficulty, forming pearly plates melting at 98°. It is lævorotatory $[\alpha]_D = -13{\cdot}6°$. It is a monobasic lactonic acid. The monoethyl ester boils at 262° at 10 mm. On oxidation it yields ammonia and pilopic acid.

When bromine acts on *iso*pilocarpine in aqueous solution at 100° in a sealed tube, the following products are formed: dibromo*iso*pilocarpinic, monobromo*iso*pilocarpinic, bromopilopinic, and bromopilopic acids, ammonia and methylamine, the two first-named acids being the chief products formed in about equal quantities.

*Dibromo*iso*pilocarpinic acid*, $C_{11}H_{14}O_4N_2Br_2$, forms rectangular crystals melting at 235°. The acid is dextrorotatory $[\alpha]_D = +24{\cdot}4°$ and is monobasic.

*Monobromo*iso*pilocarpinic acid,* $C_{11}H_{15}O_4N_2Br$, has only been obtained as a syrup.

When dibromo*iso*pilocarpinic acid is treated with sodium amalgam in alcoholic solution, pilopic acid is formed. This acid, previously described as an oil, has now been obtained in crystals melting at 103°. Both mono- and dibromo-*iso*pilocarpinic acids, on reduction with zinc and glacial acetic acid, yield a new crystalline lactone, iso*pilocarpinolactone,* $C_{11}H_{14}O_4N_2,H_2O$, which forms rectangular prisms which melt at 83°. It is lævorotatory, $[\alpha]_D = -51 \cdot 9°$, and is a neutral substance which reacts with strong alkalis, forming salts of hydroxy*iso*pilocarpinic acid, $C_{11}H_{16}O_5N_2$, which are stable. It does not unite with methyl iodide, even when heated in alcoholic solution at 100°.

Dibromopilocarpine, $C_{11}H_{14}O_2N_2Br_2$, first prepared by Pinner and Kohlhammer (*Ber.*, 1900, **33**, 1424), has been further studied; it melts at 95° when pure, and not at 79° as stated by these authors. It is dextrorotatory $[\alpha]_D = +43 \cdot 6°$, and, like its isomeride dibromo*iso*pilocarpine, is very feebly basic and does not unite with methyl iodide. On reduction, it is converted quantitatively into pilocarpine.

Efforts to prepare bromocarpinic acid, first described by the above authors, have been unsuccessful, and results have been obtained which indicate that the first action of bromine on pilocarpine at 100° under pressure is analogous to that on *iso*pilocarpine. The bromopilocarpinic acids on reduction, however, yield pilocarpinic acid, $C_{11}H_{16}O_4N_2$, thus differing from the bromo*iso*pilocarpinic acids.

Experiments on the oxidation and attempted reduction of *iso*pilocarpine were also described.

*42. "The chemical action of Bacillus coli communis and similar organisms on carbohydrates and allied compounds." By A. Harden.

Bacillus coli communis ferments glucose with production of a quantity of lactic acid corresponding to rather less than half the sugar, and of alcohol and acetic acid in approximately equivalent amounts, each representing about one-sixth of the carbon of the sugar. Small amounts of succinic and formic acids are also produced and carbon dioxide and hydrogen evolved. The carbon dioxide amounts to 12—18 per cent. of the sugar, whilst the volume of hydrogen is slightly greater. The lactic acid formed was found to be a mixture of inactive acid (25—5 per cent.) with *l*-lactic acid (75—95 per cent.). *B. typhosus* produces the same products from glucose, except that it yields a large amount of formic acid (17 per cent.) and no gas. Some of the abnormal forms of *B. coli communis* act in a similar manner on glucose, others produce the same substances but in entirely different proportions. *d*-Fructose yields the same products of fermentation by *B. coli communis* as glucose, and *l*-arabinose and *d*-galactose also yield *l*-lactic acid. Mannitol yields a much larger proportion of alcohol, 26—29 per cent., and a much smaller amount of lactic and acetic acids. The production of alcohol by this organism therefore appears to depend on the presence of the group $CH_2(OH)\cdot CH\cdot OH$ in the compound to be fermented; glycerol, which also contains this group, yields nearly half its weight of alcohol when fermented by the same organism.

Formic acid is decomposed into carbon dioxide and hydrogen (Pakes and Jollyman), but lactic acid is not attacked and hence the active lactic acid is probably not produced by the selective decomposition of previously formed inactive acid.

When asparaginic acid is the sole nitrogenous nourishment, glucose and mannitol are fermented as usual by this organism, but a large proportion of the hydrogen is absorbed and reduces the asparaginic acid to ammonium succinate.

DISCUSSION.

Mr. PAKES remarked with regard to the fact that Dr. Harden's experiments were made under anaerobic conditions, that quite different decompositions took place when the conditions were altered; for example, when nitrates were present with *d*-glucose, nitrogen was evolved instead of hydrogen; the yield of lactic and acetic acids was quite altered if the medium containing *d*-glucose had abundant oxygen either free or in the form of nitrates. Again, out of 84 strains of typical *B. coli communis* under observation at the present time, about two-thirds inverted sucrose and subsequently fermented it, the remainder, failing to invert it, did not ferment it; a similar selective power was noticed in the case of glycerin. Some, again, did not appear to be able to start the fermentation of glycerin under anaerobic conditions, but if the process were started, it would then continue anaerobically. He had observed a similar reaction with the *B. fluorescens liquefaciens* in media containing nitrates; the bacillus would not begin to grow in this medium under anaerobic conditions, but if the growth were started by the introduction of a few cubic centimetres of oxygen, the decomposition of the nitrate would continue under strictly anaerobic conditions.

Dr. HARDEN, in reply, stated that the products of fermentation, in the presence and absence of oxygen, had frequently been found to be different. Anaerobic conditions seemed likely to furnish the most interesting results. The reduction of nitrates by this organism in presence of glucose appeared to be a secondary reaction of the same order as the reduction of asparaginic acid. The variability of the action of the organism on cane sugar had been previously observed by Cushing, who, however, had not investigated the interesting question as to the inversion of the sugar by this organism.

*43. "Action of dry silver oxide and ethyl iodide on benzoylacetic ester, deoxybenzoin, and benzyl cyanide." By G. D. Lander, D.Sc.

The author has studied the action of silver oxide and ethyl iodide on benzoylacetic ester, deoxybenzoin and benzyl cyanide, as further examples of compounds analogous to acetoacetic ester (*Trans.*, 1900, **77**, 729).

With benzoylacetic ester either at the temperature of the steam-bath or in the cold, the course of the reaction is entirely similar to that of acetoacetic ester, the alkylated product consisting almost entirely of C-ethyl homologue, mixed, however, with minute quantities of β-ethoxycinnamic ester (Claisen, *Ber.*, 1896, **29**, 1006). These substances were identified by dilute alkali hydrolysis, when phenyl propyl ketone, giving an oxime, m. p. 55—56° ($N = 8{\cdot}94$ instead of 8·59 per cent.), was obtained. The alkaline hydrolysis liquid yielded small quantities of β-ethoxycinnamic acid, separating by slow crystallisation from dilute alcohol in prisms, by more rapid recrystallisation in leaflets melting at 160·5° with energetic evolution of gas, Claisen (*loc. cit.*) gives m. p. 162°; the isomeric ethylbenzoylacetic acid melts at 116°.

Only oxidation products were obtained from deoxybenzoin and benzyl cyanide.

After boiling deoxybenzoin for 8 hours with silver oxide and ethyl iodide an unchanged substance and a minute quantity of a compound (m. p. 245°) sparingly soluble in alcohol alone resulted. This latter compound was evidently bidesyl (m. p. 255°).

By the action of silver oxide on benzyl cyanide, either in the presence of ethyl iodide on the steam-bath, or in the absence of iodide in the cold, profound decomposition ensued. By rapidly heating the thick tarry product in a vacuum small distillates of dicyanostilbene were obtained (m. p. 158—159°), which gave the characteristic fluorescent green prisms of diphenylmaleic anhydride (m. p. 155°) on hydrolysis with alcoholic potash.

*44. "Alkylation of Acylarylamines." By G. D. Lander, D.Sc.

The alkylation of various acylarylamines, containing the aceto-, benzo-, oxalyl-, and oxal-residues, by means of dry silver oxide and alkyl iodides has been studied.

By means of oxide and ethyl iodide, O- or imino-ethers alone result, whereas when methyl iodide is employed the alkylation usually gives a mixture of N- or acylalkylamine, and O- or imino-homologues. Apparently the methylation of acet-*p*-toluide yields N-ether alone. A partial explanation of this anomalous action of methyl iodide is afforded by the observation that simple heating serves to convert N-phenylacetiminomethyl ether, $C_6H_5N\ C(OCH_3)CH_3$, into the N-substituted isomer.

The imino-ethers corresponding to acylarylamines are readily distinguished from the isomeric N-substituted compounds; by their liquidity at the ordinary temperature; by their boiling points, which are from 30—50° lower than those of the acylalkylamines; by the characteristic behaviour on heating of their hydrochlorides (when obtainable), regenerating acylarylamine by loss of alkyl chloride, and by their very ready hydrolysis by dilute hydrochloric acid into the original amine, acid and alcohol. The presence of a methyl group in the ortho-position in the N-*o*-tolyl imino-ethers, however, inhibits this characteristic hydrolysis, it being possible to prepare platinichlorides of these ethers from aqueous solutions. N-*α*-Naphthylacetimino-ethyl ether seems also to possess greater relative stability than the *β*-naphthylisomer.

The following compounds have been obtained: From acetylarylamines: N-*phenylacetiminomethyl ether* (with N-isomer), b. p. 197°; N-o *tolylacetiminoethyl ether*, b. p. 222°, *hydrochloride*, m. p. 90—91° (with regeneration of acetotoluide), *platinichloride*, m. p. 171°; N-o-*tolylacetiminomethyl ether* (along with N-isomer), b. p. 212° (atmos.), *hydrochloride*, m. p. 79—80°, *platinichloride*, m. p. 169°; N-p-*tolylacetiminoethyl ether*, b. p. 232° (hydrochloride unstable); N-*a-naphthylacetiminoethyl ether*, b. p. 175° (12 mm.), *hydrochloride*, m. p. 111°; N-*β-naphthylacetiminoethyl ether*, b. p. 176·5° (12 mm.). From benzanilide; N-*phenylbenziminoethyl ether*, formerly prepared by Lossen (*Ann.*, 1891, **265**, 138), b. p. 176° (12 mm.). From oxanilic ester, *semi*-N-*phenylimino-oxalic diethyl ether*, $C_6H_5N:C(OC_2H_5)\cdot CO_2C_2H_5$. The dimethyl ether has been described by Anschütz and Stiepel (*Ber.*, 1895, **28**, 61). The diethyl ether is a liquid, b. p. 152—155° (12 mm.), decomposed by dry hydrochloric acid apparently into a mixture of oxanilic ester and anhydrous oxanilic acid; with aniline at 100° it gives *diphenylamidino-oxalic ester*, $C_6H_5N:C_6H_5NH\cdot C\cdot CO_2C_2H_5$, m. p. 73—74·5°, a base giving a stable platinichloride, and passing by warming with aniline at 160—170° into *diphenylamidino-oxalanilide*, melting when rapidly heating at 140—142°, softening at 134°. From oxanilide: *di*-N-*phenylimino-oxalic diethyl ether*, $\{C_6H_5N:C(OC_2H_5)\}_2$, a viscid, brown, rather unstable oil, b. p. 205° (12 mm.).

*45. "The preparation of aliphatic imino-ethers from amides." By G. D. Lander, D.Sc.

The synthesis of imino-ethers from acid amides has only been found possible hitherto with certain aromatic amides which give stable silver salts (Tafel and Enoch, *Ber.*, 1890, 23, 103). The same authors, in a later paper (*loc. cit.*, 1550), describe unsuccessful attempts to effect the analogous synthesis from some aliphatic amides.

The author has examined the possibility of accomplishing this by the aid of dry silver oxide and ethyl iodide.

Semi-imino-oxalic diethyl ether, $NH{:}C(OEt){\cdot}CO_2Et$ (compare Nef, *Ann.*, 1895, 287, 288), boiling at 75—77° at about 20 mm., can be readily prepared from ethyl oxamate by means of silver oxide and ethyl iodide at 100°. When urethane is warmed with ethyl iodide and silver oxide, there occurs a vigorous reaction, a liquid boiling from 90—200°, along with small quantities of triethyl isocyanurate, m. p. 93—94°, being obtained. The liquid is probably a mixture of ethyl iminocarbonate, unchanged urethane, and triethyl cyanurate.

The formation of imino-carbonic diethyl ether can be demonstrated by carrying out the reaction in the cold, separating the imino-ether from unaltered urethane by distillation below 85° (20 mm.), purification by means of potassium hydroxide and conversion by hypobromite into bromiminocarbonic diethyl ether, m. p. 40—42°, 0·4 gram being thus obtained from 18 grams of urethane.

The results of several experiments with acetamide, silver oxide, and ethyl iodide, carried out either at 100° or in the cold, unfortunately still leave the question of the formation of acetiminoethyl ether by this process open. The production of a liquid base of 'imino' odour, volatile between 70° and 100°, from which, however, so far, only an oily hydrochloride has been prepared, nevertheless inclines the author to suppose that acetiminoethyl ether is actually one of the products of the reaction.

46. "Note on the latent heats of evaporation of liquids." By H. Crompton.

Imagine a saturated vapour in so attenuated a state that the gas law $PV=RT$ applies to it. Assume that it were possible at constant temperature and by compression alone to reduce the volume of the vapour V_0 to the volume which the liquid it forms would normally occupy v_0, *without any change in state occurring, and the substance during this compression continuing to obey the gas law.* The work done in bringing about this change in volume would be

$$\int_{v_0}^{V_0} p\,dv \;=\; \int_{v_0}^{V_0} \frac{RT}{v}\,dv \;=\; RT \log_e V_0/v_0$$

and, as no change in temperature occurs, heat equivalent to this work will be given out during compression.

The vapour now occupies the volume of the liquid, but it is not yet liquid. It is by assumption a gas under high pressure, and if the pressure is now reduced to its original amount, the gas would expand to its original volume. To form the liquid the substance must be brought to such a state that it would be possible to reduce the pressure to the normal vapour pressure of the liquid, without any corresponding change in volume. Assuming that no change in molecular aggregation occurs, the substance must then be deprived of the potential energy of expansion of the gas, that is, of the energy that would enable the molecules of the substance to occupy their original volume on a return to the original pressure. This energy is equal to that expended in compressing the material, namely, $RT\log_e V_0/v_0$. If this is removed in the form of heat, the total heat given out during the production of the liquid from the vapour is $2RT\log_e V_0/v_0$, and this is the latent heat of evaporation.

If, in the above, V_0 and v_0 apply to the gram-molecule, R would have the value 1·976 calories, and $2RT\log_e V_0/v_0$ would be the molecular heat of evaporation. Dividing this by the molecular weight M, the latent heat of evaporation would be obtained in the ordinary units.

The observations of Cailletet and Mathias with carbon dioxide nitrous oxide and sulphur dioxide allow the above formula to be tested for fairly wide variations in temperature and pressure. D_0 is the density of the vapour, d_0 the density of the liquid, l the latent heat of evaporation. The calculated values are obtained by the method described.

	T.	D_0.	d_0.	M.	l obs.	l cal.
Carbon dioxide	248	0·044	1·110	44	72·23	71·91
,, ,,	273	0·099	0·905	44	57·48	54·26
,, ,,	295·04	0·233	0·720	44	31·80	31·06
Nitrous oxide	253	0·044	0·998	44	66·90	70·93
,, ,, ...	273	0·081	0·890	44	59·50	58·77
,, ,, ...	293	0·151	0·755	44	43·25	42·36
Sulphur dioxide	273	0·0045	1·4338	64	91·2	97·17
,, ,,	303	0·0136	1·3520	64	80·5	86·05
,, ,,	335	0·0364	1·2425	64	68·4	70·03

In calculating the latent heats of evaporation at the ordinary boiling points of liquids, we have approximately $V_0/v_0 = 22320Td_0/273M$, if d_0 is the density of the liquid at its boiling point. In general, the calculated values are found to be about 5 to 10 per cent. higher than the observed. This may be attributed to the fact that the saturated vapour at the boiling point is not a perfect gas, and has usually a slightly higher density than that corresponding to the normal molecular weight M. With a few associating liquids, notably the alkyl alcohols, the calculated values are somewhat lower than the observed. Here, in addition to the changes described and accounted for, the production of molecular aggregates occurs on liquefaction, doubtless involving the evolution of heat. Hence the observed latent heat is higher than the calculated by this amount.

From the equation $l = 2RT(\log_e V_0 - \log_e v_0)/M$ we get $Ml/T = 2R(\log_e V_0 - \log_e v_0)$. According to the law of Trouton, Ml/T is approximately constant for liquids at their normal boiling points, and has an average value of about 21. It will be found that for most liquids V_0/v_0 varies from 300 to 400. This gives a value varying from 22·8 to 23·9 for Ml/T. As, strictly speaking, in Trouton's formula M is double the vapour density and not merely the theoretical molecular weight, slight abnormalities in the densities of the saturated vapours may account for the difference. As is well known the boiling points are approximately comparable points in the case of liquids. If liquids were truly comparable at the boiling point the ratio V_0/v_0 would be the same for all liquids at this point. Trouton's law according to the above expression would then hold absolutely.

47. "On the atomic weight of lanthanum and on the error of the 'sulphate method' for the determination of the 'equivalent' of the rare earths." By Bohuslav Brauner and F. Pavlíček.

Lanthanum material was prepared from crude cerite material and purified, first by repeated recrystallisation of the double ammonium nitrate. The nitrate was then further purified by fusion with potassium sodium nitrate, traces of cerium, praseodymium, and yttrium being thus removed, after which the material was further fractionated by this process of fusion. The purest lanthanum nitrate was next subjected to a series of fractional precipitations with potassium hydroxide so that about 7/8 of the earth was precipitated, and the most "positive" fraction contained in the filtrate was converted into the pure oxalate and designated as La 1. In the same way, fractions La 2—La 7 were obtained, La 7 being most "negative" of the series. After this followed the still more negative fractions A1—A6, obtained by fusion with nitre.

For the determination of the atomic weight the oxide (from the oxalate) was converted into the sulphate, and the conditions accompanying its formation were carefully investigated. On heating the sulphate to a constant temperature of 450° and repeatedly weighing, a gradual decrease of weight was observed until at last an approximately constant weight was obtained corresponding to an atomic weight of about La = 138. On heating the salt in an atmosphere of ammonium carbonate, further loss of sulphuric acid takes place, and an atomic weight of La = 138·2 (O = 16) was obtained with the purest material (La 1), a number which, owing to the concordant determinations of Brauner, Cleve, and Bettendorff, has hitherto been regarded as the true atomic weight of lanthanum. This number is, however, incorrect, a careful investigation having shown that the sulphate so obtained contains some of Wyrouboff's *acid sulphate.* This acid sulphate is so stable that even at temperatures above 500° some of it remains undecomposed, whilst another part of the sulphate, in the same crucible, may have undergone a partial decomposition into the basic sulphate. An aqueous solution of a sulphate so prepared shows, with ethyl orange as indicator, a strongly acid reaction, whereas the true normal sulphate obtained by repeated recrystallisation is perfectly neutral towards ethyl orange. Every sulphate obtained in this way was therefore dissolved in water, tested with ethyl orange, and a *N*/20 solution of sodium hydroxide added until the red colour of the indicator was converted into the yellow tint shown by the normal neutral lanthanum sulphate solution containing ethyl orange. The error of the atomic weight of lanthanum due to the presence of sulphuric acid in the form of an acid sulphate may amount to − 0·8 of a unit.

All "equivalent" determinations of the rare earths made by the "sulphate method" during the 19*th century are vitiated by this error.* This error is largest with the most positive lanthanum and diminishes as the basicity of the earth decreases.

After the determination and application of the above correction the single fractions of lanthanum gave the following atomic weights (means of several determinations):

La 1.	La 2.	La 3.	La 4.	La 5.	La 6.	La 7.	A 5 + 6.
138·78	138·80	138·88	138·97	138·98	139·07	139·10	139·25

The sulphate is very hygroscopic and absorbs moisture during weighing. After excluding this error completely by means of a novel cooling and weighing arrangement, it was found that a correction of + 0·2 to + 0·3 must be applied to the whole series so that the atomic weight of the most positive fraction becomes La = 139·0.

Lanthanum is a complex of two earth metals consisting, however, chiefly of the true lanthanum with the atomic weight La = 139·0. Gibbs' and Shapleigh's results confirm this, for they found for the *mixture* the atomic weight 139·7.

48. "On the atomic weight of praseodymium." By B. Brauner.

The atomic weight of this element was determined by four methods. (1) By the analysis of the anhydrous sulphate. The oxide of the approximate formula, Pr_4O_7, remaining after strong calcination of the sulphate was analysed by Bunsen's iodometric method and the weight of the pure Pr_2O_3 was determined; this series gave $Pr = 140{\cdot}95$. (2) By the analysis of the oxalate. The amount of pure Pr_2O_3 contained in the oxide Pr_4O_7, which remains after calcination was determined as in (1) and the oxalic radicle was determined by a novel gravi-volumetric method with permanganate. A series of fractions was obtained by fusion of praseodymium nitrate with nitre, but all gave the same number, $Pr = 140{\cdot}95$, so that no decomposition into different earths took place. (3) By synthesis of the sulphate. A known quantity of the oxalate containing a known quantity of the oxide, Pr_2O_3, as determined in (1) and (2) was converted into the sulphate by the usual method. Different fractions did not show any sign of decomposition, but the atomic weight deduced in this way was lower than in (1) and (2), being only $Pr = 140{\cdot}78$. As in the case of lanthanum it was found that praseodymium sulphate also does not part completely with the slight excess of free sulphuric acid (acid sulphate of Wyrouboff) on heating and therefore shows an acid reaction. Using a normal sulphate tinted with ethyl orange as indicator as the standard of comparison, this excess of sulphuric acid was determined with $N/20$ sodium hydroxide. The result of series (4) in which the error due to the hygroscopic nature of the oxide and of the anhydrous sulphate was eliminated gave the atomic weight $Pr = 140{\cdot}93$. Excluding series (2) as it was vitiated by an error which became known only at a later period, and which caused Jones and v. Scheele to obtain the incorrect number $Pr = 140{\cdot}4 — 140{\cdot}5$, the mean result is $Pr = 140{\cdot}94$.

The above results only prove that the equivalent of praseodymium is 47, so that the atomic weight is either $Pr^{I} = 47$ or $Pr^{II} = 94$, $Pr^{III} = 141$, $Pr^{IV} = 188$ or $Pr^{V} = 235$. In order to solve this question the molecular weight of the anhydrous chloride was determined by the ebullioscopic method, absolute alcohol being used as the solvent. Several determinations gave numbers for the molecular weight approaching 247·4 (this corresponds to $PrCl_3$), so that this fact, together with the analogies pointed out three years ago (*Proc.*, 1898, **14**, 71), proves definitely that the true atomic weight of praseodymium is $Pr = 140{\cdot}94$.

49. "On praseodymium tetroxide and peroxide." By B. Brauner.

When the author published his preliminary note (*Proc.*, 1898, **14**, 71) he left unsolved many of the problems connected with the black higher oxide which he was the first to prove possessed the formula Pr_2O_4. This oxide was subjected to a new and careful investigation. The only method for obtaining this oxide pure is by fusion of the nitrate with nitre, the combustion of the oxalate employed by v. Scheele, giving a very impure compound. The pure praseodymium tetroxide has a sp. gr. of 5·978 (at 20°/4° and in a vacuum); the pure trioxide, Pr_2O_3, has a sp. gr. of 7·068. The molecular volume of $Pr_2O_4 = 57·9$, that of $Pr_2O_3 = 46·7$, hence the volume of the active (the fourth) oxygen atom is $+ 11·2$, an unusually large number for the volume of 1 atom of active oxygen. Hence we can understand the great instability of the salts of the type PrX_4. The oxides, Pr_2O_4 and Pr_2O_3 combine to form a complex oxide of the approximate composition Pr_4O_7, or more correctly $Pr_{10}O_{18}$, of sp. gr. 6·704, showing that slight contraction has taken place. The *pure* praseodymium tetroxide does not give the hydrogen peroxide reaction, and is a purely *ozonic* oxide. It gives free chlorine with hydrochloric acid, ozonised oxygen with oxy-acids; in acid solution, it oxidises cerous salts to ceric salts, manganous salts to permanganic acid, and gives the characteristic violet coloration with a solution of strychnine in sulphuric acid. It "catalyses" with hydrogen peroxide in acid solution.

Praseodymium nitrate yields with hydrogen peroxide, with sodium peroxide and an alkali, the hydrated real peroxide, Pr_2O_5, belonging to the *antozonic* oxides. To the same type belongs the acetate the composition of which may be represented by the formula $Ac_2\colon Pr^{III}\cdot O\cdot O\cdot O\cdot Pr^{III}\colon (OH)Ac + H_2O$.

The maximum valency of praseodymium is tetrad, like that of cerium. The corresponding oxides have a smaller volume (greater density) than those of cerium, which it resembles most of all elements, but no place has been found in the periodic system for an element possessing the physical and chemical properties of praseodymium and its compounds.

50. "Note on neodymium." By B. Brauner.

Applying the "sulphate method" for the determination of the atomic weight of neodymium as in the case of lanthanum and praseodymium, the neodymium material, purified with sodium sulphate, gave the atomic weight $Nd = 143·80$, the correction due to the presence of the acid sulphate being determined experimentally. Neodymium forms (in the dry way) a higher oxide, Nd_2O_4, with such an extremely feeble tension (potential) of the active (fourth) oxygen atom that on liberation with acids this oxygen passes through ferrous salt solutions without oxidising them. Many other rare earths will probably form higher oxides of the same type, but their preparation and investigation offer great difficulties. These acids seem to represent the extreme limit of *ozonic* oxides.

In addition to this, neodymium yields purely *antozonic* compounds of the type R_2O_5, like the hydrated peroxide and the peculiar acetate, $Ac\dot{:}Nd^{III}\cdot O\cdot O\cdot O\cdot Nd^{III}\dot{:}(OH)\cdot Ac + H_2O$, strictly analogous to the corresponding praseodymium compounds.

The difficulties of finding a place for neodymium in the periodic system are even greater than in the case of praseodymium.

51. "Contribution to the chemistry of thorium." By B. Brauner.

The results obtained on studying the behaviour on hydrolysis of the salt, $Th(C_2O_4\cdot NH_4)_4 + 7H_2O$ (*Trans.*, 1898, **73**, 951), were applied to the fractionation and purification of commercial thorium compounds. In this way, at the one end of the series the most basic, positive fractions were obtained, that is, those which are most easily hydrolysed and termed Th_α, and at the other the most acid, negative fractions which are most easily hydrolysed, and which are called Th_β.

After removing the trivalent rare earths by methods indicated (*loc. cit.*), the atomic weight of thorium contained in the most basic (positive) fractions was determined, and the numbers $Th_\alpha = 233{\cdot}5$ (by the oxalate method) and $Th_\alpha = 233{\cdot}3$—$233{\cdot}7$ (by the sulphate method were found.

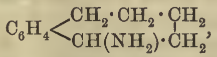
The most negative (Th_β) fractions gave at first the atomic weight $Th_\beta = 232{\cdot}5$, and this by further purification of the material decreased to $Th_\beta = 232{\cdot}0$ and $231{\cdot}9$. By working up a much larger quantity of material and trying to determine the atomic weight by the oxalate method, abnormal results were obtained owing to the easy formation of basic salts by the Th_β material, a property not possessed by the ordinary thorium salts. An extremely careful set of analyses by the oxalate method gave $R^{IV} = 236{\cdot}3$ whereas an analysis of the sulphate precipitated by alcohol from an aqueous solution which must be strongly hydrolysed gave $R^{IV} = 280{\cdot}7$. Ordinary thorium sulphate owing to only partial hydrolysis of the sulphate in the aqueous solution gives under the same conditions of precipitation $R^{IV} = 234{\cdot}6$, that is, only a slightly basic salt.

On further fractionation of the most negative (Th_β) fraction, a material was obtained which, after conversion into the normal sulphate and its analysis, gave $Th_\beta = 220$. This decrease of the atomic weight from 232 to 220 is accompanied by a decrease in the density of the oxide from 10·2 to 9·6 along with the property of the β-fractions of easily forming basic salts—a property exhibited by no known earth, with the exception of zirconium, which, however, cannot be present, may be regarded as proving the complex nature of thorium. These thoroughly established facts have been known to the author for years, but he abstains from further conclusions, especially as the study of the very complicated spectral phenomena connected with the above research proceeds but slowly.

52. "Pheno-α-ketoheptamethylene and its derivatives." By F. S. Kipping and A. E. Hunter.

The authors have continued the investigation of the ketone obtained by the action of aluminium chloride on phenylvaleric chloride (Kipand Hall, *Proc.*, 1899, **15**, 173), and have proved that it contains a seven carbon atom ring condensed with benzene in the ortho-position, as on oxidation with dilute nitric acid it yields *o*-phthalic acid.

Pheno-α-ketoheptamethylene oxime crystallises from dilute alcohol in lustrous needles melting at 108—109°; the corresponding phenylhydrazone and *p*-bromophenylhydrazone do not crystallise readily, and are oxidised on exposure to the air.

Pheno-α-aminoheptamethylene,  $C_6H_4{<}\begin{array}{l}CH_2\cdot CH_2\cdot CH_2\\ CH(NH_2)\cdot CH_2\end{array}$, is obtained when the oxime is reduced with sodium amalgam in acetic acid solution; it is a strongly basic, colourless liquid which absorbs carbon dioxide on exposure to the air.

The *hydrochloride*, $C_{11}H_{15}N,HCl$, is only moderately soluble in cold water, and crystallises in small prisms which do not melt at temperatures below 250°.

The *platinichloride*, $(C_{11}H_{15}N)_2,H_2PtCl_6$, forms orange needles. The *picrate* crystallises well and is only sparingly soluble. The *sulphate* forms thin, transparent plates and melts at about 229°; like the *oxalate*, it is only moderately soluble in water.

The *benzoyl* derivative crystallises in felted masses of needles melting at 171—172°.

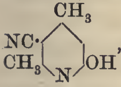
53. "Note on diphenyldinitroethylene." By J. J. Sudborough.

In the last number of the *Berichte* (1901, **34**, 619), Julius Schmidt describes two stereoisomeric *s*-diphenyldinitroethylenes, $NO_2\cdot CPh{:}CPh\cdot NO_2$, the one melting at 186—187° and the other at 105—107°. Both compounds were obtained by the direct addition of nitrogen peroxide to tolane. The compound melting at 105—107° was prepared by the author several years ago (*Diss.*, 1893; *Trans.*, 1897, **71**, 223; Richter's *Lexicon II,* 1422) by the addition of nitrogen peroxide to monochlorostilbene and the subsequent elimination of hydrogen chloride. The melting point was given as 104—105° and it crystallised in sulphur-yellow prisms and pyramids resembling those described by Schmidt. The molecular weight was determined and the action of bromine investigated but no dibromide was isolated, and no definite reduction products were obtained, but according to Schmidt the chief reduction product is αβγδ-tetraphenyl piperazine.

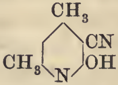
54. "Para- and ortho-cyanohydroxy-derivatives of pyridine." By J. Moir, M.A., B.Sc.

Holtzwart, by boiling an aqueous solution of the polymeride of acetonitrile, $C_4H_6N_2$, obtained a condensation product, $C_8H_8ON_2$, which he described merely as melting above 230°.

The author has further investigated this substance which is marked by extraordinary stability, and finds that it melts at 305° (corr.) and that it is, in all probability, a cyanohydroxylutidine of the constitution



, isomeric with the compound

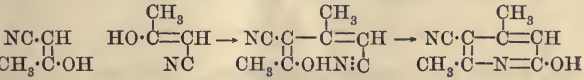


(m. p. 288—289°) which Guareschi obtained from acetylacetonamine with cyanoacetic ester.

This constitution is based on the fact, among others, that when hydrolysed by heating with strong solution of hydrogen bromide at 170°, it yields pseudolutidostyril, by exchange of hydrogen for cyanogen. All attempts to produce the intermediate carboxy-acid have failed. This acid has been obtained by Collie by an analogous reaction. Attempts to synthesise the cyano-compound from Collie's acid and ester have also been without result, owing to the stability of the compounds in question.

The mechanism of the condensation is evidently as follows:

(1) $CH_3{\cdot}C(NH_2){:}CH{\cdot}CN + H_2O \rightarrow CH_3{\cdot}C(OH){:}CH{\cdot}CN$ (cyanoacetone).

(2) 

$$\begin{array}{l}\mathrm{NC{\cdot}CH}\\ \quad\|\\ \mathrm{CH_3{\cdot}C{\cdot}OH}\end{array}\quad \begin{array}{c}\mathrm{CH_3}\\ |\\ \mathrm{HO{\cdot}C{=}CH}\\ |\\ \mathrm{NC}\end{array} \rightarrow \begin{array}{c}\mathrm{CH_3}\\ |\\ \mathrm{NC{\cdot}C{-}C{=}CH}\\ \| \quad\quad |\\ \mathrm{CH_3{\cdot}C{\cdot}OHN{:}C}\end{array} \rightarrow \begin{array}{c}\mathrm{CH_3}\\ |\\ \mathrm{NC{\cdot}C{-}C{=}CH}\\ \| \quad\quad |\\ \mathrm{CH_3{\cdot}C{-}N{=}C{\cdot}OH}\end{array}$$

The author has also found that the supposed third isomeride of $C_8H_8ON_2$, prepared by von Meyer from a compound, $C_8H_9N_3$, by the action of nitrous acid, is in reality identical with Holtzwart's isomeride. It follows that $C_8H_9N_3$ is 3-cyano-2:4-dimethyl-6-aminopyridine.

A careful physical and chemical comparison of Holtzwart's and

Guareschi's isomerides has been made, and although they resemble one another very closely, they were found to be different.

Both compounds form white, sparingly soluble needles of a very bitter taste; they are not basic, but form soluble derivatives with the alkali-metals, and cannot be directly methylated. Both resist hydrolysis with strong alkalis and acids, but give pseudolutidostyril with hydrogen bromide. They differ in their action on polarised light, and when mixed the melting point is depressed. Different compounds are obtained from each by bromination and nitration. The bromo-derivative of Holtzwart's isomeride melts at 307—308°; that of Guareschi's compound at 260—262°. The nitro-compound of Holtzwart's isomeride melts at 262° and forms yellow salts; that of Guareschi's compound melts at 271°, and forms white salts which give yellow solutions. This agrees well with the formulæ assigned to them, the former having the nitro-group in the ortho-position relatively to the hydroxyl, while in the latter case it is in the para-position.

Again, Guareschi's isomeride can be hydrolysed by warm fuming sulphuric acid, or by fusion with potash, whereas Holtzwart's isomeride cannot.

On reducing the two nitro-compounds, characteristic differences are obtained in the reactions of the amino-derivatives; while that from Guareschi's isomeride gives no colour with ferric chloride, and in alkaline solution has a strong blue fluorescence, the amino-derivative of Holtzwart's isomeride gives an indigo colour with ferric chloride, and becomes cherry-red in presence of ammonia. These reactions are also given by Collie's acid after nitration and reduction, whence it follows that they have the same configuration.

The author failed to obtain, by the action of phosphorus pentachloride on his compound, the substance $C_8H_6N_2$, described by Holtzwart.

From the pseudolutidostyril obtained in these experiments, the following derivatives were obtained:

(1) 3 : 5-*Dibromo-ψ-lutidostyril*, melting at 253° (corr.).
(2) 5-*Nitro-ψ-lutidostyril*, melting at 254° (corr.).
(3) 3-*Nitro-ψ lutidostyril*, melting at 196° (corr.).

March 28th, 1901. Anniversary Meeting. Professor Thorpe, C.B., F.R.S., President, in the Chair.

Dr. Jowett and Mr. Werner were appointed Scrutators, and a ballot was opened for the election of Officers and Council for the ensuing year, the ballot being closed at the conclusion of the President's address.

The President, in beginning his address, said that the Chemical Society was founded about four years after the accession to the throne of the Gracious Lady whose recent loss they deplored, and the memory of whose virtues and worth as a woman and as a monarch would for ever abide with them. He was proud to think that this Society, in so far as it had ministered to the progress of chemistry, may have contributed in some measure to the lustre of a reign so pre-eminently associated with the development and spread of science in this country, and with the extension of those arts which rest upon chemistry. The Society was not unmindful of what the science owed to the Royal Family, and in particular to the late Prince Consort, whose appreciative interest in the fortunes of the Royal College of Chemistry, of which he was the President, and whose friendship for the eminent man who made it the first organised school of chemical research in this country, had directly ministered to its own activity, welfare, and usefulness. The Society had sought to give utterance to these sentiments in an Address, which it ventured to submit to his Majesty on his accession to the Throne, and in respectfully tendering its congratulations, and in offering its homage, it expressed the hope that his reign would be marked by discoveries in the science it represented not less brilliant than those which characterised the reign of his illustrious mother.

The numerical strength of the Society was as follows :

Number of Fellows, March 29th, 1899		2292
" " since elected		117
" " reinstated by Council		5
		2414
Removed on account of non-payment of two annual subscriptions	28	
Withdrawn	31	
Deaths	20	79
Number of Fellows, March 28th, 1901		2335
Foreign Members		33

The names of those removed were :—Carl Bennert ; G. F. Brindley ; R. E. Brown ; James Crowther ; W. B. Edwards ; Sidney Fawns ; L. F. Goldstand ; D. A. Griffiths ; W. T. Gronow ; R. Glode Guyer ; W. G. Lasseter ; H. E. Law ; Herbert Lloyd ; J. A. MacFarlane ; E. MacSwiney ; S. M. Martin ; W. B. McVey ; E. E. Milnes ; H. J. Monson ; R. H. Owen ; J. B. Reid ; H. J. Phillips ; James Speakman ;

Thomas Stormouth; J. B. Thornley; H. W. Wallis; A. W. Warwick; R. H. Wilson.

The following have withdrawn:—E. L. Allhusen; J. Allport; Frank Bastow; F. Barker Cooke; G. H. Cross; Sir Michael Foster; J. Frost; H. E. Gardner; J. F. H. Gilbard; William Goddard; Frederic Gothard; Robert Hamilton; Harold Ellershaw Head; William M. Heller; Henry Leonard Hinnell; Alfred Kingsby Howard; Edgar Joseph; A. E. Lewis; C. T. Macadam; Fred Marsden; James Mason; John Charles Platts; Percy Morrice Randall; S. G. Rosenblum; Edward Rosling; James Spencer; James H. Stebbins; Sydney Steel; William Ward; A. Swainson Waterfield; P. A. Wier.

The following have died:—Edmund Atkinson; John Borland; Alfred Hunter Boylan; William Harcourt Branscombe; Sir John Conroy; Henry Howard Crawley; Thomas Flower Ellis; Frank W. Harris; Herbert A. Hotblack; Sir John Bennet Lawes; Stevenson Macadam; Frederick Alfred Manning; William McConnell; William Parsons; Richard Reynolds; Saville Shaw; George Smith; C. J. H. Warden; Augustus A. Wood; Thomas M. Wyatt.

The President offered on behalf of the Society its warm congratulations to its former President and Treasurer, Dr. Russell, on the attainment this year of his jubilee as a Fellow of the Society. Mr. Nevil Story Maskelyne, a former Vice-President of the Society, Sir David Gamble, C.B., and Mr. Edward Riley were also congratulated on reaching this anniversary.

During the year, the Society had joined in the commemoration of the 40th year of the doctorate of Professor Markownikoff of Moscow, one of its distinguished Foreign Members.

Since the last Anniversary, 182 communications had been made to the Society, a number greater than in any preceding year. In character, variety, and importance they compared not unfavourably with the contributions of any former period. Abstracts of all these had appeared in the *Proceedings,* while 106 have already been published in the *Transactions.* The volume of *Transactions* for 1900 contained 127 memoirs, occupying 1334 pages; in the preceding year 120 papers were published, occupying 1166 pages. The President drew particular attention to the desirability of brevity in the papers communicated to the Society.

The volumes for 1900 contain 3758 abstracts of papers, published mainly in Continental journals, occupying 1492 pages, arranged as follows:—

	Pages.	No. of Abstracts.
PART I.		
Organic Chemistry	712	1355
PART II.		
General and Physical Chemistry		467
Inorganic Chemistry		383
Mineralogical Chemistry		174
Physiological Chemistry		336
Chemistry of Vegetable Physiology and Agriculture		368
Analytical Chemistry		675
	780	2403
Total in Parts I. and II.	1492	3758

The number of abstracts dealt with in 1899 is 141 more than in the preceding year, though occupying 304 pages less.

The volume for 1900 contained no less than four Memorial Lectures, giving an account of the life-work of Victor Meyer, Bunsen, Friedel, and Nilson. The Council had determined to issue those Memorial Lectures which had appeared up to the end of 1900 in a separate form. The President in this connection paid a special tribute to the late Prof. FitzGerald, who had delivered the Helmholtz Memorial Lecture, one of the most weighty of the series.

A special reference was made to the bearing of the Copyright Bill upon the Society as a publishing agency.

As regards the Library, 810 books had been borrowed, as against 790 last year; and 95 books, 327 volumes of periodicals, and 30 pamphlets had been added, as against 114 books, 397 volumes of periodicals, and 27 pamphlets in the preceding year.

A number of books and periodicals not bearing in any way on the work of the Society had been removed from the library. Some proportion of these had been offered to and accepted by the British Museum; the remainder will be disposed of either by presentation to kindred societies or otherwise. The need of shelf room was pressing in view of the fact that the present accommodation would be exhausted in two years. The library catalogue was within sight of completion. It included 6,300 author entries and nearly as many subject entries. An estimate for printing was in preparation.

The President, referring to the result of the voting on the question of the day and hour of meeting, said the Committee had reported to the Council that the returns, however analysed, showed such a large majority in favour of the proposed change, that the Council had decided that it should be provisionally tried during the coming session. The Ordinary Meetings of next session would therefore be held on the first and third Wednesdays of the month, at 5.30 p.m.

A reference was made to the movement for a uniform system of atomic weights, and it was announced that the Atomic Weights Committee had decided to recommend (1) that $O = 16$ be taken as the basis of calculation of atomic weights; (2) that in assigning a number as the atomic weight of any element only so many figures should be employed that the last may be regarded as accurately known to one unit in that figure.

Grants amounting to £160 had been made from the Research Fund in aid of chemical investigation.

Dr. ARMSTRONG proposed a vote of thanks to the President, coupled with the request that he would allow his address to be printed in the *Transactions.*

Prof. SMITHELLS seconded the motion, which was carried by acclamation.

The PRESIDENT having returned thanks,

Prof. TILDEN, F.R.S., the Treasurer, in giving an account of the Balance Sheet which he laid before the Society, duly audited, said:—

The receipts had been:—By admission fees and subscriptions, £4290; by sale of Journal and advertisements, £880 12*s.* 9*d.*; and by dividends on invested capital, £464 14*s.* 4*d.* The total receipts from all sources amounted to £5668 19*s.* 8*d.* The expenses had been: —On account of the Journal, £3512 9*s.* 11*d.*; on account of the Proceedings, £250 15*s.*; on account of the preparation of a new Catalogue, £51 16*s.* 4*d.*; on account of the Library, £238 15*s.* 11*d.*; House expenses, £210 9*s.* 11*d.*; the total expenditure being £4832 3*s.* 9*d.*

The TREASURER, in concluding, proposed a vote of thanks to the auditors, which was acknowledged by Mr. PAGE.

Prof. EMERSON REYNOLDS, F.R.S., proposed a vote of thanks to the Officers and Council.

Prof. COLLIE, F.R.S., seconded the motion, which was unanimously adopted. Prof. DUNSTAN, F.R.S., responded.

The Scrutators having presented their report to the President, he declared that the following had been duly elected:—

President: J. Emerson Reynolds, D.Sc., M.D., F.R.S.

Vice-Presidents who have filled the office of President: Sir F. A. Abel, Bart., G.C.V.O., K.C.B., D.C.L., F.R.S.; H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.;

James Dewar, M.A., LL.D., F.R.S.; Sir J. H. Gilbert, Ph.D., LL.D., F.R.S.; J. H. Gladstone, Ph.D., D.Sc., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.B., F.R.S.; W. H. Perkin, LL.D., Ph.D., F.R.S.; Sir H. E. Roscoe, D.C.L., LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., Ph.D., D.Sc., LL.D., For.Sec.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: E. Divers, M.D., D.Sc., F.R.S.; C. E. Groves, F.R.S.; Prof. Herbert McLeod, F.R.S.; Prof. H. A. Miers, M.A., F.R.S.; T. Purdie, Ph.D., F.R.S.; T. Stevenson, M.D.

Secretaries: Wyndham R. Dunstan, M.A., F.R.S.; A. Scott, M.A., D.Sc., F.R.S.

Foreign Secretary: Raphael Meldola, F.R.S.

Treasurer: William A. Tilden, D.Sc., F.R.S.

Other Members of Council: H. Brereton Baker, M.A.; F. D. Chattaway, Ph.D., D.Sc.; Frank Clowes, D.Sc.; A. W. Crossley, Ph.D., D.Sc.; A. E. Dixon, M.D.; Prof. J. J. Dobbie, M.A., D.Sc.; H. J. H. Fenton, M.A., F.R.S.; M. O. Forster, Ph.D., D.Sc.; D. Howard; S. U. Pickering, M.A., F.R.S.; W. J. Pope; James Walker, D.Sc.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society took place at the Whitehall Rooms, on Wednesday, March 27th, at 7 p.m., when the following Fellows and their guests dined together:—

Abney, Sir W. de W., K.C.B., F.R.S.
Adams, Mr. M. A.
Alldred, Mr. C. H.
Atkinson, Mr. G. D.

Barlet, Mr. S.
Beadle, Mr. Clayton.
Beaven, Mr. E. S.
Bevan, Mr. E. J.
Blakesley, Mr. G. H., *Master of the Mercers' Company.*
Bowley, Mr. J. J.
Brough, Mr. B. H.
Brown, Dr. H. T., F.R.S.

Callendar, Prof., F.R.S., *Treasurer of the Physical Society.*
Carr, Mr. F. H.
Carteighe, Mr.
Central News.
Chancellor, The Rt. Hon. the Lord.
Chapman, Mr. A. C.
Church, Sir W. S., Bart., M.D., *President of the Royal College of Physicians.*
Clerk, Mr. D.
Collart, Mr. H.
Collis, Mr. W.
Connah, Mr. J.
Crossley, Dr.

Daily News, The.
Dewar, Prof., F.R.S.
Divers, Prof., F.R.S.
Dixon, Prof. H. B., F.R.S.

Dobbie, Prof.
Donnelly, Sir John, K.C.B.
Dunstan, Prof., F.R.S., *Hon. Secretary.*
Dyer, Dr.
Dyer, Sir W. T. Thiselton-, K.C.M.G.

Epps, Mr. James.

Farmer, Prof., F.R.S.
Fenton, Mr. H. J. H., F.R.S.
Forster, Dr.
Fowler, Rev. Prof., *Vice-Chancellor, University of Oxford.*
Furneaux, Mr. J. R., *Master of the Leathersellers' Company.*

Greenaway, Mr. A. J., *Sub-Editor.*
Griffith, Mr. G.
Groves, Mr. C. E., F.R.S.
Guttmann, Mr. O.

Hall, Mr. Samuel.
Harrison, Mr. E. F.
Hartley, Mr. H. B.
Harvey, Mr. E. W.
Hehner, Mr. O.
Henley, Mr. F. R.
Hill, Mr. A. Croft.
Hill, Mr. C. A.
Hopkins, Dr. F. Gowland.
Houlding, Mr. W.
Howie, Mr. W. L.
Hutchinson, Mr. C. C.

Jackson, Mr. Henry.
Jones, Mr. H. O.

Kellner, Dr.
Kelvin, Rt. Hon. Lord, G.C.V.O., *President of the Royal Society of Edinburgh, Master of the Clothworkers' Company.*
Kemp, Mr. W. J.
Kempe, Mr. A. B., F.R.S., *Treasurer of the Royal Society.*
Kenny, Dr.
Kohn, Dr.

Le Sueur, Mr. H. R.
Lewkowitsch, Dr.
Ling, Mr. A. R.
Lockyer, Sir Norman, K.C.B.
Luxmoore, Dr.

MacEwan, Mr. P.
McLeod, Prof., F.R.S.
MacMahon, Major, R.A., F.R.S.
Markham, Mr. E.
Martindale, Mr. W.
Maxwell, Rt. Hon. Sir Herbert, Bart., M.P.
Meldola, Prof., F.R.S., *Foreign Secretary.*
Messel, Dr.
Mond, Dr. R.
Moody, Dr.
Morley, Dr. Forster.
Morris, Dr. G. H.
Morton, Mr. E. H.
Mowatt, Sir Francis, G.C.B. *Secretary to the Treasury.*
Müller, Dr. Hugo, F.R.S.

Nicholson, Dr.

Orton, Dr.

Page, Mr. F. J. M.
Perkin, Dr. W. H., F.R.S.
Pope, Mr. W. J.
Power, Dr.
Prideaux, Sir Walter, *Clerk of the Goldsmiths' Company.*
Pritchard, Prof.

Ramsay, Prof., F.R.S.
Reynolds, Prof. J. Emerson, F.R.S., *President-Elect.*
Robbins, Mr. J.
Roberts, Sir Owen, *Clerk of the Clothworkers' Company.*
Robertson, Dr.
Roscoe, Sir Henry, F.R.S., *Vice-Chancellor, University of London.*
Roundell, Mr. C. F.
Russell, Dr. W. J., F.R.S.
Ryder, Mr. G. L., C.B., *Chairman H.M. Board of Customs.*

Sadler, Col., M.P.
Salamon, Mr. A. Gordon.
Schweich, Mr. E.
Scott, Dr., F.R.S., *Hon. Secretary.*
Scott, Mr. E. L., *Clerk of the Salters' Company.*
Seaton, Dr. E. C.
Smithells, Prof.
Spiller, Mr.
Spooner, Mr. F.
Standard, The.
Steele, Mr. R., *Assistant-Secretary and Librarian.*
Stevenson, Dr. T.
Strutt, The Hon. R. J.
Sullivan, Dr. Washington.
Swan, Mr. J. W., F.R.S., *President of the Society of Chemical Industry.*

Thompson, Prof. S. P., F.R.S., *President of the Physical Society.*
Thomson, Prof., F.R.S., *President of the Institute of Chemistry.*
Thorpe, Prof., C.B., F.R.S., *The President.*
Tilden, Prof. F.R.S., *Treasurer.*
Times, The.
Tutton, Mr. A. E., F.R.S.

Voelcker, Dr. J. A., *President of the Society of Public Analysts.*

Wade, Mr. J.
Watson, Mr. C.
Werner, Mr. E. A.
Wilkinson, Mr.
Williams, Mr. G., R.N.
Wyllie, Mr. C. W.
Wynne, Dr., F.R.S., *Editor.*

The following toasts were proposed :—

By the PRESIDENT.

1. His Most Gracious Majesty the King.
2. Her Majesty the Queen Alexandra, their Royal Highnesses the Duke and Duchess of Cornwall and York, and the other Members of the Royal Family.

By the TREASURER.

3. The Houses of Legislature, coupled with the names of the Rt. Hon. The LORD CHANCELLOR, and the Rt. Hon. Sir HERBERT MAXWELL, Bart., M.P., F.R.S.

By the Rt. Hon. LORD KELVIN, G.C.V.O., F.R.S., *President of the Royal Society of Edinburgh, and Master of the Clothworkers' Company.*

4. Prosperity to the Chemical Society.

By Professor DEWAR, F.R.S.

5. The Learned and Scientific Societies, coupled with the names of Mr. A. B. KEMPE, *Treasurer of the Royal Society*, and Professor SILVANUS P. THOMPSON, F.R.S., *President of the Physical Society.*

By Professor EMERSON REYNOLDS, M.D., F.R.S., *President-Elect of the Chemical Society.*

6. The Guests, coupled with the names of Sir W. S. CHURCH, Bart., M.D., *President of the Royal College of Physicians*, and Sir FRANCIS MOWATT, G.C.B.

By Sir HENRY E. ROSCOE, F.R.S., *Vice-Chancellor of the University of London.*

7. The retiring President.

In proposing the loyal toasts, The President, while paying the Society's tribute to the late Queen, said they could have no manner of doubt that the King would worthily follow in her footsteps. That the King would long rule over the splendid heritage to which he had succeeded, and that his reign might be marked with the same full measure of prosperity, intellectually and morally, which had graced the reign of Victoria, was their constant hope and confident anticipation.

The Treasurer, Professor Tilden, in proposing the toast of the Houses of Legislature, said they did not seek the honour of the presence of so many members of both Houses at their dinner that evening solely for the purpose of enjoying their society. The fact was the Chemical Society, old and respectable as it was, had to give a sort of account of itself in the face of the world, and nowhere was it so important that the objects of the Society, and the benefits they thought it conferred upon the community, should be recognised as in the Houses of Legislature. Some of them were rather anxious as to the part which science had to play and the position which science was to occupy in the national programme. Science demanded a much more influential place in the councils of the nation than had hitherto been granted it.

The Lord Chancellor, in responding for the House of Lords, said he had feared from the Treasurer's speech that they were about to be subjected to a quantitative and qualitative analysis, but was glad to see it pass off into a homily upon the importance of infusing into Parliament a more scientific spirit. He was always glad to use the phrase Parliament, because although, for obvious purposes, it was desirable that it should be divided into two Chambers, he always liked to regard that great instrument of human enlightenment and freedom as being one, and he would lament anything which interfered with the working of that great constitutional machine. He believed that the House of Commons had that day been distinguishing itself in its energy to procure chemically pure beer. (Laughter.) He, unfortunately, had no such claim to make for the House for which for the moment he had the honour to respond. He did not believe they had been dealing either with beer or science during this Session, except so far as military science might be supposed to demand public attention. He accepted with the most perfect good faith the exhortation which he had received from the proposer of the toast, and so far as he could influence either public opinion or the action of the House of Lords, he would never forget what they owed to science. He had heard it whispered—he would not say by unkind friends—that their work in manufacturing Acts of Parliament was not absolutely perfect, but the more they advanced in the science of language, in perfecting precision in organising human thought and reasoning, the plainer they would make to the popular understanding the meaning of an Act of Parliament. Nothing could more induce to the making of clear laws than a scientific education, which would bring about an assiduity of reasoning and clearness of thought.

Sir HERBERT MAXWELL, Bart, M.P., in responding for the House of Commons, said though much had been said in condemnation of that House he submitted that its present Members were not worse than those who had gone before. Though they might conduct their business in a way which would disgrace a self-respecting company, they were not so indifferent to the work of scientists as they appeared to be. They would, for instance, as soon condemn a witch to be burnt as discuss a subject of a scientific nature, such as that which had occupied them that afternoon, without taking the advice of the experts of the question. He asked that they would rather judge of the result of their labours than the way in which that result was attained. He took the opportunity of specially thanking the Chemical Society for the aid and hospitality it had recently afforded the Committee on Food Preservatives, of which he was Chairman.

Lord KELVIN, in proposing the toast of THE CHEMICAL SOCIETY, said he was perfectly appalled at the magnitude of the work he was asked to commend to their notice. When he thought of all that had been done in chemistry during the last century, he was convinced he would in no way be exaggerating when he said that chemistry was the first and last science of the nineteenth century. It only began to exist as a science at the close of the eighteenth century. He was a physicist and he could assure them that physicists had to go to chemistry all through their work. The physicist wanted to measure everything, and now in particular they wanted to know the weight of an atom of hydrogen and the number of molecules in a litre of hydrogen. They were, he was glad to say, in a fair way of learning it, thanks to the labours of chemists. Chemists must stick to dynamics. The chemist had to do with the forces between particles of matter from the hundred-millionth of a gram in weight to the thousand millionth, and had to look to the forces between them, and tell the number of their particles in a litre of water or beer, and say how many of those atoms were arsenic, and how many atoms of arsenic might be allowed. They had learned within the month that some amount of arsenic might be allowed—that without arsenic man could not exist, that an essential in the composition of the human body was the seventeen-hundredth of a gram of arsenic in the thyroid gland. Chemistry was the first and the last science of the nineteenth century, and only recently had given them what ancient chemists would have been glad to have seen—namely, liquid air and liquid hydrogen. He referred eloquently to the work of the great chemists of the past, especially of the first president of the Society, Professor Graham, and to that of Lord Rayleigh and Professors Ramsay and Dewar. To their labours the physicist owed much, and there was no reason whatever why chemistry and physics should not go hand in hand, helping one another and working cordially together for the advancement of knowledge. Some of the work of the physicist was looked upon as drudgery. Chemists knew a great deal about drudgery too, and did not shrink from it. Lord Rayleigh devoted himself to working painfully and laboriously at an object which looked trivial, the finding of the density of atmospheric nitrogen, and he discovered that it contained a gas that had never even been suspected before. That was a triumph for drudgery. In looking back to the early history of the Chemical Society he took some pride in thinking that Glasgow took its part, in that it provided the first president, and that Dr. Thorpe had been Professor of Chemistry at the Andersonian Institute there. The Chemical Society though but young, only 61 years old, had a glorious past, and he believed a splendid and prosperous future before it.

The PRESIDENT, in reply, said no matter how they regarded the Society, whether from the point of view of its numerical strength or from the character of its scientific output or from the lower ground of its financial condition, he thought there was no constitutional infirmity about it. This happy result was largely to be attributed to that constant accession of strength they gained in the increase of membership. There was no English chemist of note who was not proud of being a member of their body, whilst they had in their ranks almost every foreign chemist of prominence. The honorary membership of their Society was a distinction as highly prized as any mark of recognition which a body of scientific workers could bestow. There were signs of many changes in the chemical world, but whatever the future might have in store for them, he who occupied the presidential chair in the year 2001, and who in ushering in the new century sought to know what was being done when the preceding century was dying, would, he was convinced, do them the justice to recognise that they who collectively made up that body corporate were, according to their several rights and within the measure of their individual powers, doing what within them lay to further the true object of their calling as men of science, the attainment of the truth for the sake of the truth.

Professor DEWAR, in proposing the toast of the learned and scientific societies, said that whenever any body of men had associated themselves for the purpose of discovery,.invention, or the verification of truth, then the Chemical Society was most desirous of recognising the advantage of their labours on behalf of the community and of chemistry especially. Chemists were particularly desirous of recognising the great benefits which accrued from the corporate action of so many minds in the multitudinous departments of scientific work. He spoke of the dangers of exaggerating the importance of personality in matters of scientific research, as scientific work was always based on the labours of the past.

Mr. A. B. Kempe, Treasurer of the Royal Society, in reply, said there was one point on which the progress of their Society was not so satisfactory as he could wish it to be. That was in the matter of financial support. It was true they had much to thank private beneficence for, and he thought it was a matter of congratulation that His Majesty's Government had in the person of Mr. Balfour recognised the value of pure science. As Treasurer of a scientific society, however, he felt, and he was sure treasurers of other societies felt the same, that they might promote the interests of mankind rather more than they did at present, if they had a little more money to devote to the work.

Professor S. P. Thompson, F.R.S., referred particularly to the great work chemists had done in the matter of artificial illumination. He trusted the century now opening would see still greater advances and that the scientific bodies wherever their work seemed to cross or coincide would work hand in hand for the good of all.

Professor Emerson Reynolds, President-Elect, proposed the toast of the Guests, which was responded to by Sir W. S. Church and Sir Francis Mowatt.

Sir Henry Roscoe proposed the health of the Chairman.

ADDITIONS TO THE LIBRARY.

I. Donations.

Coux, H. de la. L'eau dans l'industrie. Paris 1900.
From the Publishers.

Dibdin, W. J. Lime, mortar and cement: their characteristics and analyses, with an account of artificial stone and asphalt. London 1901.
From the Author.

Perkin, F. M. Qualitative chemical analysis, organic and inorganic. Ill. London 1901. From the Author.

Shenstone, W. A. The elements of inorganic chemistry, for use in schools and colleges. Ill. London 1901.

—— Laboratory companion for use with Shenstone's inorganic chemistry. London 1901. From the Author.

II. By Purchase.

Fränkel, Sigmund. Die Arzneimittel-Synthese auf Grundlage der Beziehungen zwischen chemischum Aufbau und Wirkung. Berlin 1901.

Jüptner, H. F. v. Grundzüge der Siderologie. 1st part. Die Konstitution der Eisenlegierungen und Schlacken. Ill. Leipzig 1900.

Meyer, Arthur. Die Grundlagen und die Methoden für die mikroskopische Untersuchung von Pflanzenpulvern. Ill. Jena 1901.

Bois-Reymond, E. du. Vorlesungen über die Physik des organischen Stoffwechsels. Ill. Berlin 1900.

Wischin, R. A. Die Naphthene (cyklische Polymethylene des Erdöls) und ihre Stellung zu anderen hydrürten cyklischen Kohlenwasserstoffen. Braunschweig 1901.

Ashmole, Elias. Theatrum Chemicum Britannicum. London 1652.

Ripley reviv'd : or, an exposition upon Sir George Ripley's hermetico-poetical works. Written by Eirenæus Philalethes. London 1678.

At the next meeting, on Thursday, April 18th, 1901, the following papers will be communicated :—

"Researches on moorland waters. Part II. On the origin of the combined chlorine." By W. Ackroyd.

"Robinin, violaquercitrin, and osyritrin." By A. G. Perkin.

"Preparation of orthodimethoxybenzoin, and a new method of preparing salicylaldehydemethylether." By J. C. Irvine.

"Action of alkyl haloids on aldoximes and ketoximes. Part II." By Wyndham R. Dunstan and E. Goulding.

"The supposed existence of two isomeric triethyloxamines." By Wyndham R. Dunstan and E. Goulding.

"Nitrocamphene, aminocamphene, and hydroxycamphene." By M. O. Forster.

"Action of hydroxylamine on the anhydrides of bromonitrocamphane." By M. O. Forster.

"The influence of cane sugar on the conductivities of potassium chloride and potassium hydroxide, with evidence of salt formation in the latter case." By C. J. Martin and O. Masson.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 236.

April 18th, 1901. Professor EMERSON REYNOLDS, F.R.S., President, in the Chair.

Messrs. B. F. Howard, L. Dobbin, W. H. Oates, and Maj.-Gen. Waterhouse were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Guy Ashwell, Standard Bank, Bulawayo; Thomas Aspinall, 42, Gilnow Road, Bolton; William George Aston, 4, Dalkeith Road, Ilford; Edwin Sloper Beaver, 5, Bonham Terrace, Warminster; Fred Bedford, 9, Market Place, Sleaford, Lincs.; Arthur Crabtree, 9, Bigg Market, Newcastle-on-Tyne; Daniel McLaren, Brookdale, Grey Street, Stalybridge; John Powell, Balliol House, Wentworth Street, E.; John Davidson Spence, 2, Hawkhill Place, Perth Road, Dundee; William Arthur Whitton, Bristol Brewery, Brighton.

The following certificate was authorised by the Council under bye-law I (3):

Joseph de Verteuil, Clarence Street, Port of Spain, Trinidad, B.W.I.

The following letter has been received from Prof. Markownikoff in reply to the letter of congratulation (p. 1) addressed to him by the Council:

Moscow, $\frac{\textit{22nd March,}}{\textit{4th April.}}$

DEAR SIR,

Some years ago I was highly honoured to be received into the list of Foreign Members of the most appreciated Chemical Society of

London, and am now deeply moved by the new sign of attention and the hearty congratulations of my dear colleagues.

I beg you to convey to them that devotion to our science will not leave me until the very last.

Your respectful obedient servant,
W. MARKOWNIKOFF.

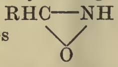
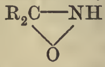
Prof. MELDOLA,
Foreign Secretary.

EXTRAORDINARY GENERAL MEETING.

The PRESIDENT stated that, having received a requisition signed by a sufficient number of Fellows asking that an Extraordinary General Meeting of the Society be called to consider the change of the day and hour of meeting which the Council had decided upon for the ordinary meetings during the ensuing session, he had fixed Wednesday, May 15th, at 8 P.M. for this meeting.

Of the following papers, those marked * were read :

*55. "Action of alkyl haloids on aldoximes and ketoximes. Part II. Alkylated oximes and isoximes and the constitution of aliphatic oximes." By W. R. Dunstan and E. Goulding.

In a previous paper (*Trans.*, 1897, 71, 573) the authors showed that the direct action of alkyl haloids on aldoximes and ketoximes results in the formation of alkyl nitrogen derivatives only, these being derivatives of the isoximes  and  . When the alkyl haloid acts on the sodium derivatives of the oximes, that is, on the oximes in presence of sodium methoxide, these derivatives of the isoximes are formed, but together with the true ethers of the oximes, RHC:NOH and R_2C:NOH.

The alkyl isoximes are highly unstable, and have been studied chiefly as the compounds they form with sodium iodide. On hydrolysis they furnish the corresponding aldehyde or ketone, together with a β-substituted hydroxylamine. On reduction in the ordinary manner they are converted into the primary amine of the substituted alkyl and the corresponding aldehyde or ketone. By careful reduction with sodium amalgam and acetic acid in alcoholic solution they are changed, by substitution of hydrogen for oxygen, into the corresponding secondary amines. This is a satisfactory method of preparing pure secondary amines.

The alkyl ethers of the oximes are stable liquids. On hydrolysis they furnish the aldehyde or ketone and an α-substituted hydroxylamine.

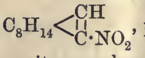
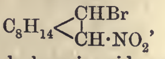
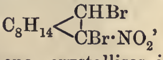
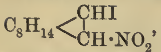
Isomeric alkyl derivatives of acetaldoxime, acetoxime, and acetophenoxime were described, and also their hydrolytic and reduction products.

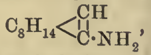
The authors consider that their results support the view that the isoximido-form represents the ordinary structure of the aliphatic oximes, only alkyl nitrogen derivatives being obtained from them by the direct action of alkyl haloids, the hydroxylic structure in the formation of ethers being determined by the formation of the so-called "salts" with highly electro-positive metals. These salts are, however, readily dissociated, so that by acting on them, in alcoholic solution, with the alkyl haloid some alkyl isoxime is always formed from the free oxime present.

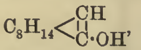
*56. "The supposed existence of two isomeric triethyloxamines." By W. R. Dunstan and E. Goulding.

The triethyloxamine, $(C_2H_5)_3NO$), obtained by the authors (*Trans.*, 1899, **75**, 792, and *Trans.*, 1900, **77**, 1006) was shown to possess properties which differ from those of the compound described by Bewad, to which he assigned the same constitution. This difference has been since investigated and confirmed by Lachman (*Ber.*, 1900, **33**, 1022), who, however, was unable to offer any explanation of it. The question is now settled by the observation that the compound described by Bewad is in reality β-ethyl-*sec*-butylhydroxylamine, as Bewad himself has shown (*Journ. Russ. Phys. Chem.*, 1900, **32**, 455). The triethyloxamine obtained by the authors is at present, therefore, the only known compound having this constitution.

*57. "Nitrocamphene, aminocamphene, and hydroxycamphene." By M. O. Forster.

1-*Nitrocamphene*,  $C_8H_{14}<\begin{array}{l}CH\\ \|\\ C\cdot NO_2\end{array}$, prepared by heating an alcoholic solution of 1 : 1-bromonitrocamphane with silver nitrate, crystallises from alcohol in long, hard, striated prisms and melts at 56°; it has $[\alpha]_D = +112\cdot0°$ in alcohol, and $+137\cdot5°$ in benzene. 2 : 1-*Bromonitrocamphane*,  $C_8H_{14}<\begin{array}{l}CHBr\\ |\\ CH\cdot NO_2\end{array}$, obtained when nitrocamphene is treated with hydrobromic acid, crystallises from alcohol and melts at 178°. 1 : 2-*Dibromo*-1-*nitrocamphane*,  $C_8H_{14}<\begin{array}{l}CHBr\\ |\\ CBr\cdot NO_2\end{array}$, produced by the action of bromine on nitrocamphene, crystallises in long, flat, transparent needles and melts at 195°. 2:1-*Iodonitrocamphane*,  $C_8H_{14}{<}\genfrac{}{}{0pt}{}{CHI}{CH\cdot NO_2}$, prepared from nitrocamphene and hydriodic acid, crystallises in thin, lustrous plates and melts at 118°.

1-*Aminocamphene*,  $C_8H_{14}{<}\genfrac{}{}{0pt}{}{CH}{C\cdot NH_2}$, formed on reducing nitrocamphene with zinc dust and glacial acetic acid, melts at 46°, and boils at 191—192° under 758 mm. pressure; it has $[\alpha]_D = +59\cdot7°$ in alcohol. The ***sulphate***, ***picrate***, ***platinichloride***, and the ***benzoyl***, ***benzylidene***, and ***phenylcarbamide*** derivatives are well-defined.

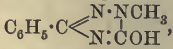
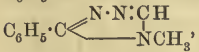
1-*Hydroxycamphene*,  $C_8H_{14}{<}\genfrac{}{}{0pt}{}{CH}{C\cdot OH}$, obtained on heating aminocamphene sulphate with potassium nitrite, crystallises in long needles, melts at 74° and boils at 212° under 750 mm. pressure; it has $[\alpha]_D = +34\cdot1°$ in absolute alcohol. Hydroxycamphene is indifferent towards alkalis, but warm dilute mineral acids transform it immediately into ordinary camphor.

*58. "A contribution to the chemistry of the triazoles."

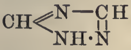
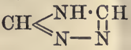
By G. Young and W. H. Oates.

The authors discuss the possibility of isomerism in the triazole series as compared with the pyrazoles.

The following compounds have been obtained:

Benzal-2-methylsemicarbazone, $C_6H_5\cdot CH{:}N\cdot N(CH_3)\cdot CO\cdot NH_2$, m. p. 159—160°; 3-*phenyl*-1-*methylhydroxytriazole*,  $C_6H_5\cdot C{<}\genfrac{}{}{0pt}{}{N\cdot NCH_3}{N{:}COH}$, m. p. 218—219°; *acetyl* derivative, m. p. 72·5—73°, *silver* derivative, $C_9H_8ON_3Ag$; 3-*phenyltriazole*, m. p. 118·5—119°; *cinnamal-2-methylsemicarbazone*, m. p. 155°; *styrenylmethylhydroxytriazole*, m. p. 204—205°; *silver* derivative, $C_{11}H_{10}ON_3Ag$; *acetyl* derivative, m. p. 88—89°; m-*nitrobenzalmethylsemicarbazone*, m. p. 207—208°; m-*nitrophenylmethylhydroxytriazole*, m. p. 285—285·5°; *silver* derivative, $C_9H_7O_3N_4Ag$; *benzoyl*-4-*methylthiosemicarbazide*, $C_6H_5\cdot CO\cdot NH\cdot N{:}C(SH)\cdot NHCH_3$, m. p. 198°; 2-*phenyl*-1-*methyltriazole*,  $C_6H_5\cdot C{<}\genfrac{}{}{0pt}{}{N\cdot N{:}CH}{NCH_3}$, m. p. 112—113°; 2-*phenyl*-1-*methylmercaptotriazole*, m. p. 163—164°. Methylsemicarbazide, formed by the action of potassium cyanate on methylhydrazine sulphate, has the methyl group in position (2), $NH_2\cdot N(CH_3)\cdot CO\cdot NH_2$, and not in position (1), $CH_3NH\cdot NH\cdot CO\cdot NH_2$ (compare Brüning, *Ann.*, 1889, 253, 11).

DISCUSSION.

Dr. SILBERRAD pointed out that Knorr's theory affords a better explanation than that given by the author of facts such as that illustrated by the identity of the triazoles represented by the formulæ  $\mathrm{CH}<\begin{array}{l}\mathrm{N-CH}\\ \qquad\|\\ \mathrm{NH\cdot N}\end{array}$ and  $\mathrm{CH}<\begin{array}{l}\mathrm{NH\cdot CH}\\ \qquad\|\\ \mathrm{N-N}\end{array}$, a phenomenon to which attention was drawn on the conversion of dihydrotetrazine into the triazole represented above (Hantsch and Silberrad, *Ber.*, 1900, **33**, 89).

In reply, Dr. YOUNG said that the identity of Freund's triazole with that prepared from tetrazine was in agreement with the view put forward in the paper as to the "amidine" nature of the triazole ring.

59. "Researches on moorland waters. Part II. On the origin of the combined chlorine." By W. Ackroyd.

The object of the investigation has been to discover the origin of the common salt in the water of the Widdop reservoir in Yorkshire, about midway between the two seas, this water being continually removed and as continually replenished from a saltless area of Millstone Grit and Yoredale rocks. The chlorine in the winter rainfall more than accounts for it, and the conclusions arrived at are (1) that the combined chlorine in the reservoir water is wholly derived from rain water; (2) that the quantity of chlorine in the reservoir, whose capacity is 640½ million gallons, closely approximates to a yearly average of 1·188 parts per 100,000, and (3) that in winter the chlorine in the rainfall is in excess of the average for other seasons of the year.

60. "Robinin, violaquercitrin, and osyritrin." By A. G. Perkin.

Robinin, isolated from the flowers of *Robinia pseudacacia* by Zwenger and Dronke (*Ann. Sup. I*, 1861, 257) was considered by them as a glucoside of quercetin. The formula $C_{33}H_{38}O_{20},8H_2O$ is now assigned to the air-dried substance, and its decomposition with dilute mineral acids may be thus represented, $C_{33}H_{38}O_{20} + 4H_2O = C_{15}H_{10}O_6 + 3C_6H_{12}O_6$. The *colouring matter*, $C_{15}H_{10}O_6$, melts at 271—272°, yields a *sulphate*, $C_{15}H_{10}O_6,H_2SO_4$, and a *tetracetyl* derivative, $C_{15}H_6O_6(C_2H_3O)_4$. On decomposition with alkali, phloroglucinol and *p*-hydroxybenzoic acid are formed. It is identical with *kampherol*, which is present as its monomethyl ether, kampheride, in galanga root (*Alpinia officinarum*) (Gordin, *Dissert.*, Berne), and as glucoside in *Delphinium consolida* (*Proc.*, 1900, **16**, 182). The sugar gave a mixed osazone, from which dextrosazone (m. p. 204—205°) and a more soluble compound, m. p. 190—196° (possibly the galactose derivative), were isolated.

Osyritrin, the quercetin glucoside of *Osyris compressa* (*Trans.*, 1897, **71**, 1131), has at 130° the formula $2C_{27}H_{28}O_{16},H_2O$, and not $C_{27}H_{30}O_{17}$, as previously stated. Air dried, it contains $3H_2O$, and is anhydrous at 160°. Violaquercitrin (Mandelin, *Jahres.*, 1883, 1369), present in the *Viola tricolor*, has at 160° the formula $C_{27}H_{28}O_{16}$, and not $C_{42}H_{42}O_{24}$ ($=C_{27}H_{26}O_{15}$) there given. Air dried, it contains $3H_2O$, and is identical with osyritrin.

61. "Preparation of orthodimethoxybenzoin, and a new method of preparing salicylaldehyde methyl ether." By J. C. Irvine, B.Sc.

The author described a new and rapid method of obtaining salicylaldehyde methyl ether. A mixture of salicylaldehyde and methyl iodide reacts energetically with dry silver oxide, giving a brown oil, from which a 90 per cent. yield of the pure product is obtained on distillation. The product (b. p. 236—238°) readily solidifies to a crystalline mass melting at 39—40°. On boiling with potassium cyanide in alcoholic solution, this substance may be condensed to *o*-dimethoxybenzoin, a yellow, crystalline solid melting at 101·5°. A notable reaction of this benzoin is its quantitative conversion into the corresponding methyl ether by the action of silver oxide and methyl iodide. This substance crystallises from ether in prisms melting at 59—60°.

62. "Action of hydroxylamine on the anhydrides of bromonitrocamphane." By M. O. Forster.

The compound $C_{10}H_{17}O_2N_2Br$, obtained by the action of hydroxylamine on the anhydrides of 1 : 1-bromonitrocamphane, crystallises from alcohol in rectangular plates and melts at 197°; it reduces ferric chloride and ammoniacal silver nitrate. The *hydrochloride, sulphate, picrate, platinichloride*, and the *carbamide* and *benzoyl* derivatives are well-defined. When nitrous acid acts on the substance, the anhydride melting at 240° is regenerated, and potassium permanganate oxidises it to the compound $C_{10}H_{14}O_2NBr$.

The compound $C_{10}H_{16}O_2N_2$, produced by the action of aqueous sodium hydroxide on the foregoing hydroxylamino-derivative, crystallises in rhomboidal plates and melts at 208°; the *picrate* and *platinichloride* are well-defined.

63. "On the estimation of cocaine and on di-iodo-cocaine hydriodide." By W. Garsed and J. N. Collie, F.R.S.

The object of this research was to find a method for the fairly accurate estimation of cocaine in small quantity.

The estimation of cocaine in presence of cinnamyl cocaine and isatropyl cocaine, and other substances, with which it is associated in coca leaves has not been attempted, the method only dealing with the estimation of cocaine when free or mixed with benzoyl ecgonine and ecgonine, the products of hydrolysis of pure cocaine. When a solution of cocaine in the form of a salt containing about 1 per cent. of cocaine base is titrated by adding excess of decinormal iodine solution till the supernatant liquid contains excess of iodine, a precipitate of di-iodo-cocaine hydriodide, $C_{17}H_{21}NO_4HII_2$, is formed. The excess of iodine in solution can then be estimated by a decinormal sodium thiosulphate solution. The precipitated di-iodo-compound can be collected and weighed, or the cocaine estimated by the amount of iodine used. Any cocaine salt can be used since the potassium iodide in the solution reacts with the salt, producing the iodide. Di-iodo-cocaine hydriodide is a remarkably stable and crystalline compound, crystallising in large, glistening crystals of constant composition.

Cocaine can be estimated in presence of ecgonine, as ecgonine forms a soluble iodo-compound.

Benzoyl ecgonine, however, interferes to a considerable extent with the estimation of cocaine. Making use of the fact that both benzoyl ecgonine and ecgonine are insoluble in ether or light petroleum, a separation can be effected, as cocaine is soluble in both these solvents. The extracted cocaine can then be weighed directly or titrated with iodine.

64. "Note on acetonylacetone." By T. Gray.

The density (0·973) and refractive index (1·4232) of acetonylacetone, purified by conversion into the bisulphite compound, $C_6H_{10}O_2,2NaHSO_3 + H_2O$, and regeneration therefrom, were determined, and the molecular refraction $\mathfrak{M}_D = 29{\cdot}85$ found to agree with the value required by the "keto"-formula. Attention was directed to the readiness with which acetonylacetone is resinified by alkalis, by concentrated sulphuric acid and by gaseous hydrochloric acid.

65. "Condensation of acetonylacetone with hydrazine hydrate." By T. Gray.

The products of the interaction of acetonylacetone and hydrazine hydrate were described. Condensation in molecular proportions results in the formation of a base, $C_{12}H_{20}N_4$, b. p. 157—158° at 13 mm. which readily oxidises in air; it forms a hydrochloride, $C_{12}H_{20}N_4,2HCl$, and a chloroplatinate, $C_{12}H_{20}N_4,H_2PtCl_6$. The product of the reaction of the ketone with excess of hydrazine hydrate is a white, crystalline substance having the formula $C_{12}H_{24}N_6$, m. p. 130—132°. The substance gradually undergoes decomposition at the ordinary temperature, is a powerful reducing agent, and is readily decomposed by dilute acids with formation of hydrazine salts.

66. "Preparation of synthetical glucosides." By H. Ryan, M.A., D.Sc., and W. S. Mills, M.A.

Acetochlorogalactose was obtained as a faint yellow, semi-solid syrup slowly soluble in cold alcohol, hot ligroin, ether and chloroform, scarcely soluble in cold ligroin, by the action of acetyl chloride on well-dried galactose in a dry, cooled, sealed tube. It was extracted with chloroform, washed with ice water and cold sodium carbonate solution; the chloroform solution, dried with calcium chloride and evaporated in a vacuum, left acetochlorogalactose.

By the action of α-naphthol and potassium hydroxide on acetochlorogalactose in alcoholic solution, *α-naphthylgalactoside* ($C_6H_{11}O_5{\cdot}O{\cdot}C_{10}H_7$) was obtained as rectangular plates soluble in hot alcohol and hot water, slightly soluble in cold water, insoluble in ether, chloroform, benzene and ethyl acetate. It reduces Fehling's solution after inversion by hot dilute sulphuric acid. The galactoside does not dissolve in dilute potash, and melts at 202—203°.

m-*Cresylglucoside* was obtained from acetochloroglucose and *m*-cresol in alkaline solution as long, silky, branching needles, scarcely soluble in benzene, chloroform, ethyl acetate, and carbon bisulphide, soluble in cold water and alcohol, readily soluble in hot water and alcohol. It reduces Fehling's solution only after hydrolysis by dilute sulphuric acid, m. p. 167·5—168·5°.

The carvacryl glucoside already prepared from acetochloroglucose was obtained from carvacrol potash and acetobromoglucose prepared by the method of Königs.

67. "The influence of cane sugar on the conductivities of solutions of potassium chloride, hydrogen chloride, and potassium hydroxide; with evidence of salt formation in the last case." By C. J. Martin and O. Masson.

Sugar-solution is generally considered to be a non-electrolyte, but in view of the fact that saccharates exist, it may more probably be viewed as a very slightly ionised acid. To test this point, the conductivities of solutions of hydrogen chloride and of potassium chloride containing varying amounts of sugar were determined, and it was found that the conductivity did not appreciably differ from that of aqueous solutions of these compounds, except in so far as the viscosity of the sugar solution had to be allowed for. On the other hand, when sodium hydroxide was added to sugar solutions of different strengths, it was obvious that the sugar took part in the conduction, and this is attributable to the formation of sodium saccharate, which, like other salts, is largely ionised in dilute solution. The conductivity, even in this last case, was of course influenced by the viscosity of the sugar solution, but even after allowing for this, the proof of ionisation was unmistakable.

68. "The aluminium-mercury couple. Part III. Chlorination of aromatic hydrocarbons in presence of the couple. The constitution of the dichlorotoluenes." By J. B. Cohen and H. D. Dakin.

The authors have continued their investigation on the action of the aluminium-mercury couple as a halogen carrier in the preparation of the chlorine derivatives of the aromatic hydrocarbons. They have obtained in this way a series of chlorobenzenes from mono- to hexa-chlorobenzene as well as mono-, di-, and tri-chlorotoluenes. Their work was, however, chiefly devoted to the identification of the dichlorotoluenes formed by this process, a subject which has been under investigation since 1866, with very conflicting results. By careful fractional crystallisation of the following solid derivatives of the mixed dichlorotoluenes, nitro-, dinitro-, sulphonic acids and salts, sulphonic chlorides and amides, and the dichlorobenzoic acids obtained by oxidation, and by a comparison of these with the same derivatives of the six isomeric dichlorotoluenes which they have prepared in a pure state, the authors have now proved that four, namely, ($CH_3 = 1$), 1 : 2 : 3, 1 : 2 : 4, 1 : 2 : 6, and 1 : 3 : 4 and very probably 1 : 2 : 5 dichlorotoluenes are formed in this reaction. The authors propose to investigate the dibromotoluenes in the same manner, as no very satisfactory evidence has been given of the nature of the mixture formed by brominating toluene.

69. "A modification of Gutzeit's test for arsenic." By E. Dowzard.

An apparatus to free the gas from hydrogen sulphide, &c., by washing was described along with a series of experiments, which show that lead acetate solution only absorbs hydrogen sulphide, whilst a 15 per cent. solution of cuprous chloride in hydrochloric acid absorbs hydrogen sulphide, stibine, and phosphine, but has no effect on arsine.

70. "On the chemistry of 'Nerium odorum.'" By R. C. L. Bose, M.B.

In his investigations on the poisonous constituents of *Nerium odorum*, the sweet-scented oleander, two methods of analysis of the roots were employed by the author, namely, that adopted by Greenish (*Pharm. Journ.*, 1881, [iii],11, 873), with certain modifications, and the method of plant analysis of Dragendorff. A third active constituent, besides the two already discovered in the root by Greenish, neriodorein and neriodorin, has thus been discovered, and named *karabin*, from *karabi*, the Bengali name of the plant.

The root gave the following percentages of the different extracts by Dragendorff's method: light petroleum extract, 2·88; ether extract, 1·38; absolute alcoholic extract, 3·40; aqueous extract, 5·81 per cent.

The ether extract was found to contain the *karabin*. This extract was partly soluble in absolute alcohol, giving a clear yellow solution, and on being evaporated to dryness left a brownish-yellow, sticky residue, *karabin*, which on analysis gave numbers corresponding to the formula $C_{21}H_{49}O_6$.

The alcoholic extract contained a substance identified as the neriodorin, and the aqueous extract contained the neriodorein. Neriodorein is readily soluble in water, neriodorin in boiling water only, while *karabin* is insoluble both in cold and boiling water. Neriodorein and neriodorin are insoluble in ether and benzene, but *karabin* dissolves readily in both. The colour reactions with concentrated sulphuric acid are also distinctive.

The author was also able to separate *karabin* by employing the following modification of Greenish's plan of analysis. The acidified aqueous solution of the alcoholic extract of the root was first shaken up with light petroleum, which removed a quantity of a viscid, yellowish, oily substance. After the separation from the light petroleum, the solution was next agitated with ether *instead of chloroform*. The ethereal solution on evaporation left a brownish-yellow residue which gave all the reactions of *karabin*. The acidified fluid was next agitated with chloroform, which caused the separation of some oily looking globules which floated between the two layers of fluids; these were separated, washed, and evaporated to dryness; the residue gave all the reactions of neriodorein. The chloroform solution was then separated, and on evaporation left a golden-yellow brittle residue which satisfied all the tests for neriodorin.

The author considers that neriodorin is a variety of saponin. Neriodorein is very readily soluble in water, forming a pale yellow solution of neutral reaction which froths considerably on agitation. It has the acrid taste of saponin, and satisfied most of the tests for this widely distributed substance. It also closely resembles, in its behaviour with certain reagents, the variety of saponin described by the author and Warden (*Pharm. Journ.*, 1882, [iii], **12**, 302).

The author believes that both neriodorin and karabin are not glucosides but possess the characters of a resin; neither contains nitrogen.

71. "Change and interaction in organic compounds."
By A. Lapworth.

The apparently very general law to which the author has recently endeavoured to draw attention (this vol., p. 2) receives a very simple explanation if it be supposed that isomeric change is due to dissociation and that *the dissociation between two atoms which leads to change in organic compounds exists, in general, only once in the molecule at any instant.* Such a view leads to the $\alpha\gamma$- and $\alpha\beta$-rules, whether the labile group in an isomeric change never leaves the molecule as previously suggested (*Trans.*, 1898. **73**, 448), or whether ionisation occurs, for the above law holds true for weak electrolytes. In the author's opinion, therefore, the cause of change in general in organic compounds is probably to be sought for in a dissociation resembling ionisation, doubtless often in very small amount, a view arrived at independently of Euler (*Ber.*, 1900, **33**, 3202), and Zengelis (*Ber.*, 1901, **34**, 198), who use a similar assumption in order to explain the phenomena of hydrolysis and etherification.

The influence of a catalytic agent might be of very varying character and can only be properly discussed in reference to particular cases. It may not only increase the velocity of change by raising the concentration of ions representing a labile group in isomeric change, or remove certain ions from the sphere of action by converting them into undissociated compounds, a suggestion which has been made by Euler and Zengelis, but, what is of equal importance, it may convert a molecule into an individual possessing the properties of a dissociated group or ion by supplying simpler groups with which it may unite, a process analogous to the formation of a complex ion by union of a simple ion with a neutral component (compare Abegg and Bödlander, *Zeit. anorg. Chem.*, 1899, 20, 453).

It is to be observed that a molecule may also become a dissociated group by union with a dissociated part of a substance directly concerned in an interaction.

The atom from which a group has been removed will, of course, have an apparent valency of one unit less than that which it has in an undissociated compound; such an atom may be said to be "*subvalent*," or to represent a position of "*subvalency.*" Whilst the atoms within a dissociated group will not change their relative positions in any way, the position of "subvalency" may conceivably be altered by a slight readjustment of the mutually attractive forces between the atoms; the removal of a group from one already dissociated does not mean a double dissociation, but the transference of the subvalency (and charge) to that group, and is analogous to the conversion of a complex ion into a simple ion and a neutral component. Perhaps, therefore, the above law should be stated—*No alteration of the relative positions of the atoms in a dissociated group can take place, and as a rule only one position of subvalency exists in such a group at any instant, in other words, it is usually subvalent.*

By means of the conception, the following rule may be deduced for some cases of interaction. If, during a reaction, a group M might be expected to become associated, even momentarily, with an atom R_α in the complex, $\cdot R_\alpha \cdot R_\beta : R_\gamma$, then the product may contain, not only substances with the grouping $R_\alpha M \cdot R_\beta : R_\gamma$, but also, and sometimes exclusively, those with the grouping, $R_\alpha : R_\beta \cdot R_\gamma M$, or their tautomeric forms.

This rule at once gives some reason for the simultaneous formation of *ortho-* and *para-*derivatives when substitution occurs in a benzene mono-derivative, and for the similar but more complicated phenomena in the naphthalene series. Certain equations of considerable interest and importance may also be deduced. For example, if $X \cdot Y + A : B = AX \cdot BY$ is a possible reaction, then, expanding in terms of the rule, we obtain the following possibilities:

$$X \cdot Y + A : B_\alpha \cdot B_\beta : B_\gamma = AX \cdot B_\alpha : B_\beta \cdot B_\gamma \quad \text{. . . . .} \quad (R)$$

at once recognisable as the form to which so much importance has been attached by Thiele.

$$X \cdot Y_\alpha \cdot Y_\beta : Y_\gamma + A : B = AX \cdot BY_\gamma \cdot Y_\beta : Y_\alpha \quad \text{. . . . .} \quad (S)$$

a form which is not translatable in terms of Thiele's rule. It is probably the basis of the Claisen reaction, the reactions between aldehydes and phenols, or the alkali salts of isonitro-compounds, and the change which occurs when *o*-acetylacetoacetic ester is converted into diacetylacetic ester by a trace of alkali. Expanding both B and Y, we obtain the form

$$X\cdot Y_\alpha\cdot Y_\beta:Y_\gamma+A:B_\alpha\cdot B_\beta:B_\gamma=AX\cdot B_\alpha:B_\beta\cdot \dot{B}_\gamma\cdot Y_\gamma\cdot Y_\beta:Y_\alpha \quad . \quad . \quad . \quad (T)$$

which finds examples in the interactions of ethyl sodio-acetoacetate, malonate, cyanacetate, &c. (*iso*-forms), or $\alpha\beta$-unsaturated esters and ketones. In the above examples, $X=K$ or Na, and $Y_\alpha=O$.

72. "The mechanism of the Claisen reaction." By A. Lapworth.

The author takes the following view of this reaction in its simplest form :

(1) A sodium ion unites with the carbonyl group of the ketone or ester to form a subvalent group which then loses a hydrogen ion, $\dot{Na}+O:CR^1\cdot CH_2R^2\rightarrow Na\cdot O\cdot \dot{C}R^1\cdot CH_2R^2\rightarrow Na\cdot O\cdot CR^1:CHR^2+\dot{H}$. The apparently direct replacement of a hydrogen atom in many esters, ketones, or even hydrocarbons (Thiele, *Ber.*, 1901, **34**, 68) is probably to be ascribed to the same cause; the reaction with hydrocarbons may be represented, $\dot{K}+CR_2:CR\cdot CHR_2\rightarrow CR_2K\cdot \dot{C}R\cdot CHR_2\rightarrow CR_2K\cdot CR:CR_2+\dot{H}$, or, another possible type, $CHR:CR_2+\dot{K}\rightarrow CHRK\cdot \dot{C}R_2\rightarrow CRK:CR_2+\dot{H}$.

(2) The metallic derivative then dissociates, part reacting with a subvalent group—produced by union of a sodium ion with ethyl oxalate, formate, &c.—as roughly represented by equation S (see preceding abstract).

$$Na\cdot O\cdot CR^1:CHR^2 + CR^3(OEt):O \longrightarrow [\dot{O}\cdot CR^1:CHR^2 + \dot{C}R^3(OEt)\cdot ONa]$$
$$\longrightarrow O:CR^1\cdot CHR^2\cdot CR^3(OEt)\cdot NaO \longrightarrow O:CR^1\cdot CR^2:CR^3\cdot ONa + HOEt.$$

In the case of ethyl crotonate (*Proc.*, 1900, **16**, 132) the $\alpha\gamma$-rule must be applied a stage farther, $Na\cdot O\cdot C(OEt)\overset{1}{:}CH\cdot CH:CH_2+ O:C(OEt)\overset{2}{\cdot}CO_2Et = Na\cdot O\cdot C(OEt)\overset{2}{}(CO_2Et)\cdot CH_2\cdot CH:CH\cdot C(OEt)\overset{1}{:}O = Na\cdot O\cdot C(CO_2Et):CH\cdot CH:CH\cdot CO_2Et+HOEt$.

Exactly similar changes may be supposed to go on in the case of *o*-nitrotoluene, but here the nitro-group takes the place of the carbonyl group in the above cases. In *p*-nitrotoluene a further extension of the $\alpha\gamma$-rule is involved.

The action of hydrogen chloride in promoting the condensation of aldehydes with ketones, phenols, &c., may be ascribed to a similar series of changes, the hydrogen ions acting perhaps in this way :

(1) $\dot{H}+O:C(CH_3)\cdot CH_3\rightarrow H\cdot O\cdot \dot{C}(CH_3)\cdot CH_3\rightarrow H\cdot O\cdot C(CH_3):CH_2+\dot{H}$.

(2) $\dot{H}+O:CHPh\rightarrow H\cdot O\cdot \dot{C}HPh$.

(3) $\dot{O}\cdot C(CH_3):CH_2+\dot{C}H(OH)Ph\rightarrow O:CMe\cdot CH_2\cdot CH(OH)Ph\rightarrow O:CMe\cdot CH:CHPh+HOH$.

Further experiments on diethyl oxalocrotonate (*Proc.*, 1900, 16, 132) have strengthened the belief that it is the γ-oxalo-derivative; it has the normal molecular weight in acetic acid.

γ-*Oxalocrotonic acid*, $CO_2H\cdot C(OH)\colon CH\cdot CH\colon CH\cdot CO_2H$, is a strong acid which is sparingly soluble in the ordinary organic media. It melts and decomposes at about 190°, being converted into α-pyrone-α′-carboxylic acid. Its aqueous solution gives an intense black colour with ferric chloride which is not discharged by a large excess of hydrochloric acid.

Preliminary experiments on other αβ-unsaturated esters and ketones indicate that the following substances yield acidic compounds resembling ethyl oxalocrotonate: ethyl dimethylacrylate, ethyl β-chlorocrotonate, phorone, camphorone and benzylidenemesityl oxide. The products, which have as yet been obtained only as oils, give intense black colorations with ferric chloride; they are still under examination.

Ethyl α-methylacrylate, which does not contain the requisite grouping, gives no product of a similar kind, indicating that it is not the mere presence of the group $\cdot CH_2\cdot\dot{C}\colon\underset{\cdot}{\dot{C}}$ which is necessary.

73. "A new series of di-mercuri-ammonium salts. Part I." By P. C. Rây, D.Sc.

When a solution of mercuric nitrite is treated with ammonia in slight excess, a di-mercuri-ammonium nitrite of the formula $2NHg_2NO_2,H_2O$ is formed; if this compound be dissolved in hydrochloric acid and the solution evaporated nearly to dryness, a white crystalline salt of the formula $NHg_2Cl,4HCl$ is obtained. Hydrobromic acid also yields the corresponding double bromide $NHg_2Br,4HBr$. Both haloid salts dissolve in water and if the solutions be cautiously treated in the cold with dilute potassium hydroxide, the chloride and bromide, $2NHg_2Cl,H_2O$ and $2NHg_2Br,H_2O$, are formed respectively.

At the next meeting, on Thursday, May 2nd, there will be a ballot for the election of Fellows, and the following paper will be communicated:—

"The synthetical formation of bridged-rings. Part I. Some derivatives of bi*cyclo*pentane." By W. H. Perkin, jun., and J. F. Thorpe.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 2, 1901.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

Anderson, William Carrick,

2, Florentine Gardens, Hillhead, Glasgow.

Assistant to Professor of Chemistry and Lecturer on Chemistry, Glasgow University. Bachelor of Science, 1894 (Glasgow University). Master of Arts (with Honours in Natural Science), 1893. Doctor of Science (Glasg.), 1899. Papers: "Method of Determining Sp. Gravity of Coke" (*J. Soc. Chem. Ind.*, 1896); "A Contribution to the Chemistry of Coal" (*Phil. Soc. of Glasgow*, 1897); "Some Chemical Properties of Scotch Coal" (*J. Soc. Chem. Ind.*, 1899); "A New Form of Potash Bulb" (*ibid.*, 1899); "The Estimation of Iodine in Presence of Cyanides" (*ibid.*, 1899); "The Chemistry of Coke" (Glasgow: Wm. Hodge & Co., 1899), Simmersbach & Anderson; "The Recovery of Nitrogen in Coal Distillation" (*J. Soc. Chem. Ind.*, 1899); "The Oxidation of Ammonia by Iron Ore" (*ibid.*, 1900).

John Ferguson.
G. G. Henderson.
Thomas Gray.
Matthew A. Parker.
James Robson.
James Roberts.

Blake, George Stanfield,

Purley Lodge, Purley, near Croydon.

Analytical Chemist. Assistant in the Imperial Institute Laboratories. Associate of the Royal School of Mines in Metallurgy. Two years chemist to the Royal Mines of Elba; 18 months chemist with Edward Riley, 2, City Road, E.C.

Wyndham R. Dunstan.
R. L. Jenks.
H. H. Robinson.
Ernest Goulding.
Thomas Anderson Henry.

Bolton, Edward Richards,

7, Leazes Terrace, Newcastle-on-Tyne.

Managing chemist at Messrs. Trobridge and Co.'s Works, Gateshead-on-Tyne. Studied various branches of Chemistry for the past seven years, both in England and Germany—at King's College, London, and under Prof. Fresenius, also with others in both countries. Am desirous of becoming a member of the Society that I may more closely follow such branches of Science as would aid me in directing my manufactures.

John M. Thomson. Patrick H. Kirkaldy.
Herbert Jackson. J. A. Voelcker.
Charles J. S. Makin.

Bousfield, Edward George Paul,

St. Swithin, Hendon.

Student. Some time at Castner-Kellner Works engaged in Electricity and Chemistry. At present doing research work at Central Technical College, &c.

Henry E. Armstrong. Edward W. Lewis.
Gerald T. Moody. William A. Lethbridge.
T. M. Lowry.

Burgess, Percival James,

Singapore.

M.A. Sidney Sussex College, Cambridge. Government Analyst to the Straits Settlements. Formerly Assistant Demonstrator in the University Chemical Laboratory, Cambridge.

G. D. Liveing. H. J. H. Fenton.
W. J. Sell. W. T. N. Spivey.
F. W. Dootson.

Carter, William,

7, Victoria Street, Clitheroe.

Research Assistant in Organic Chemistry at Blackburn Technical School. Student, Blackburn Technical School, 1895—1897. Student, Royal College Science, 1898—1899, and Owens College, 1899—1900. Now Private Research Assistant to Dr. R. H. Pickard, Blackburn Technical School. Joint author with Dr. Lawrence of papers on "The Hydroxyphenoxy- and Phenylene-di-oxy-acetic acids and derivatives of Ethyl α-methyl-β-phenyl cyan-glutarate."

H. B. Dixon. W. H. Perkin, jun.
Wm. A. Bone. J. F. Thorpe.
W. T. Lawrence. Robert H. Pickard.

Clark, Ernest,

9, Polygon Avenue, Stockport Road, Manchester.

Assistant Lecturer in Chemistry at the Royal Technical Institute, Salford. Student for 4 years at University College, Sheffield; for 1 year at the Owens College, Manchester. Assistant Lecturer in Chemistry for 2 years at Royal Technical Institute, Salford. Published two papers (with Dr. G. Young) on "Naphthyl Carbamides," and "Action of Ammonia and Substituted Ammonias on Acetyl Urethane." B.Sc., London. Late 1851 Exhibition Scholar.

W. Carleton Williams. W. H. Perkin, jun.
George Young. Jas. R. Appleyard.
William H. Oates. *Ernest Witham.*

Cockburn, Thomas Kennedy,

26, Elm Street, Whiteinch, Glasgow.

Analytical Chemist. Student in the Laboratory of Messrs. Tatlock & Thompson, Glasgow. Chemist to the Glasgow Portland Cement Company, Ltd. Assistant Chemist to the Millom and Askam Hæmatite Iron Company, Ltd. Assistant to F. W. Harris, F.C.S., Glasgow Corporation Chemist.

R. R. Tatlock. R. T. Thomson.
Jas. D. Dougall. F. W. Harris.
Horatio Ballantyne.

Coddington, Eustace,

131, St. James's Road, Upper Tooting, London, S.W.

Science Master, King Henry VIII. School, Coventry. Open Scholarship for Natural Science at Downing College, Cambridge. Natural Science Tripos, Part I., 1899, Second Class B.A.

W. J. Sell. W. T. N. Spivey.
Henry Jackson. H. O. Jones.
Matthew Whittam.

Crocker, Walter Stevens,

25, Upper Parliament Street, Liverpool.

Chemist and Under-Brewer, Mersey Brewery, Liverpool. Student at the Royal College of Science, London, 1889—1892, taking the Associateship in Chemistry under Dr. Thorpe, F.R.S. Assistant Lecturer and Demonstrator in Chemistry and Physics, Hartley College, Southampton, 1892—4; Assistant to the Southampton Borough Analyst, 1895. Lecturer in Chemistry, Physics, and Geology, Northcroft, Bath, 1896—8. Science Master (Chem. and Phys.), Grammar

School, Gillingham, Dorset, 1898—1900. Appointed as above, December, 1900.

T. E. Thorpe. W. Palmer Wynne.
Leonard Temple Thorne. *F. J. M. Page.*
H. Brereton Baker.

Dakin, Henry Drysdale,

9, Beech Grove Terrace, Leeds.

Student at the Yorkshire College, Leeds. Over four years with Leeds City and County Analyst; three years Student at the Yorkshire College. Published paper with Dr. Cohen on the "Bromination of Aromatic Compounds" (*Trans.*, **75**, 893); also papers on the "Estimation of Zinc" (*Zeitschrift. f. anal. Chem.*, **39**, 273) and of "Manganese and Cobalt" (*ibid.*, 784).

Arthur Smithells. H. M. Dawson.
Julius B. Cohen. B. A. Burrell.
Thomas Fairley.

Dubois, Raymond,

Rutherglen, Victoria.

Principal of Viticultural and Œnological College. B.Sc. (Paris). Diplomé, École d'Agriculture de Montpellier. Commissioned by the French Government to study and report on the date palm industry in the Oued Rhir from a scientific and commercial point of view. Published report on date palm industry. Translation of "L'Industrie viticole méridionale," by L. Roos; translation of "Guide ampelographique," by M. Mazade; translation of "Traitement des Vins et leurs Maladies," by Malvezin. Compilations: "Trenching and Subsoiling for American Vines," "Sterilisation of Wines," "Herbaceous Grafting," "The Composition of Natural Wines," a paper read before the Austr. Assoc. for the advancement of science. Delivered many public lectures on diseases of wines, casse in wines, chemistry of wines generally, &c., &c.

C. R. Blackett. H. W. Potts.
A. W. Craig. *Orme Masson.*
Henry C. Jenkins.

Duckworth, William Henry,

87, New Bank Road, Blackburn.

Assistant Lecturer and Demonstrator in Chemistry, Blackburn Municipal Technical School. Also Assistant to Dr. R. H. Pickard. Consulting Chemist and Gas Examiner to the Corporation of Blackburn.

Robert H. Pickard. W. E. Bickerdike.
T. Slater Price. W. B. Hards.
C. Gerland.

Dunstan, Albert Ernest,

24, Lidfield Road, Stoke Newington, N.

A Science Master at Owen's School, Islington. B.Sc. London (Hon.'s Chem. Inter. Sci.). I am desirous of keeping in touch with recent chemical work.

William A. Tilden.	G. T. Morgan.
W. Palmer Wynne.	James C. Philip.
M. O. Forster.	*Chapman Jones.*

Eastick, Samuel Philip,

25, Woodville Road, Ealing.

Chemist and Engineer. Studied as Government Teacher four years at Royal School of Mines and Normal School of Science under Professors Frankland, Huxley, Guthrie, Judd, and others; passed 1st or 2nd class in all subjects. Hold teachers certificates in almost every science under the S. and A. Dept. Studied technical chemistry two years under Prof. Lunge at Zurich. Held appointments as chemist for about six years at Beckton Gas Co., Forbes Abbott and Lennard MacDougal Bros., and Kellner Partington Pulp Co., Ltd. About eight years' experience in foreign countries as Chemical Engineer, &c.

L. J. de Whalley.	Chas. E. Eastick.
B. E. R. Newlands.	*Arthur R. Ling.*
Theo. D. Lichtenstein.	*John Heron.*

Ellis, Hugh Edward,

18, Belmont Road, Aberdeen.

Teacher of Chemistry, School of Pharmacy, Robert Gordon's College, Aberdeen (for the past two and half years); late Demonstrator in Chemistry, Northern College of Pharmacy, Manchester; formerly student of Chemistry at the University College of Wales, Aberystwyth, the Northern College of Pharmacy, &c.; Pharmaceutical Chemist and Member of the Pharmaceutical Society.

Herbert McLeod.	J. F. Tocher.
George Clayton.	H. Lloyd Snape.

F. R. Japp.

Eyre, John Vargas,

26, Bridge Road West, Battersea Park, S.W.

Junior Demonstrator in Chemical Laboratory, and Research Assistant to Professor Meldola, F.R.S., at Finsbury Technical College.

R. Meldola.	Edward W. Lewis.
F. Southerden.	Chas. R. Darling.
Gerald T. Moody.	*William A. Lethbridge.*

Hanley, John, A.I.C.,

4, Guion Road, Litherland, Liverpool.

Analyst, now in the employ of J. Bibby and Sons, Liverpool. Three years Technical Chemist to Bancroft and Co., Limited, Liverpool (oils, fats, soap). Three years Student, University College, Liverpool. Five years working out original processes in a private laboratory. Six months Bacteriology, University College, Liverpool. Two years Senior Chemist with J. Bibby and Sons, Liverpool, establishing above process in oils, fats, soaps, glycerine, stearine, oleine, feeding cake, &c.

T. H. Lloyd. H. B. Stocks.
J. Campbell Brown. Joseph T. Freestone.
George Tate.

Harrison, John Ansted,

47, London Road, Neath, Glamorganshire.

Science Master, the County School, Neath. B.Sc. (Lond.) First Division. Honours in Chemistry and Geology. Associate of the Royal College of Science (Lond.) in the Division of Chemistry. Science Student at Mason College (2 years), and the Royal College of Science (3 years). Author of "First Steps in Earth-knowledge."

William A. Tilden. *W. H. Deering.*
W. Palmer Wynne. *T. H. Dodd.*
Lionel M. Jones. *Oliver Trigger.*

Henley, Francis Robert,

Watford, Rugby.

B.A., Oxford (Honours in Chemistry). Engaged in Study of Chemistry of Brewing.

D. H. Nagel. H. B. Hartley.
A. F. Walden. A. Vernon Harcourt.
S. A. Ionides.

Higgs, Henry Herbert,

26, Anglesey St., Lozells, Birmingham.

Schoolmaster. B.Sc. (Lond.). Five years Assistant Schoolmaster (Science) at King Edward's School, Aston, Birmingham.

T. Francis Rutter. *E. J. Cox.*
William Round. *C. F. Baker.*
Albert H. Turton. *Percy F. Frankland.*

Hyder, Alfred James,

22, Gunton Rd., Upper Clapton, London, N.E.

Teacher of Chemistry. (Inter.) B.Sc. London University and Honours, Inorganic (Practical), of Science and Art Department. I desire to attend Chemical Society's meetings, to have Journal published by the Society, and use of the Library, as I take much interest in chemical work.

J. T. Hewitt. Edgar S. Barralet.
Frank Dixon. *F. D. Chattaway.*
K. J. P. Orton.

Jemmett, William Henry Coutts,
Tintern, Gap Road, Wimbledon.

Senior Chemistry Master at Owen's School, Islington. 1st Class, Nat. Sci. Tripos, Part I., Cambridge, 1893, Chemistry being one subject of examination. Teacher of Chemistry for over seven years. Desirous of following modern developments in Chemistry.

F. H. Neville. C. T. Heycock.
Holland Crompton. William J. Pope.
Stuart Blofeld.

McKenzie, Alex.,
Jenner Institute, Chelsea Gardens, London, S.W.

Grocers' Company Research Student. M.A., D.Sc. (St. Andrews), Ph.D. (Berlin); Author of "Active and Inactive Phenylalkyloxyacetic Acids" (*Trans.*, **75**, 753); "A Contribution to the Chemistry of the Mandelic Acids" (*ibid.*, **75**, 964); Inaugural-Dissertation, Berlin, 1901, "I Teil: Ueber eine neue Methode zur Spaltung racemischer Verbindungen in die activen Bestandteile. II Teil: Ueber die Abscheidung von Isobutylcarbinol und Methylaethylcarbincarbinol aus Gährungsamylalkohol." Also conjointly with W. Marckwald, author of several papers in the *Berichte*, 1899, 1900, 1901.

Henry E. Roscoe. Arthur Harden.
G. Druce Lander. Harold G. Colman.
J. H. van't Hoff.

Lewis, Ernest Alfred,
310, Dudley Road, Birmingham.

Analytical Chemist, Assayer, and Metallurgist. 1895, 1896, Student at Mason College, Birmingham; 1897, 1898, Assistant at Muntz's Metal Co., Ld., French Walls, near Birmingham; since 1899, Chemist and Metallurgist to Muntz's Metal Co., Ltd. Published an article on "The Effect of Arsenic on Copper," in *Chemical News*, Jan. 4th, 1901. Have done research work on "The Effect of very Dilute Acids on Metals and Alloys," and "On the Microstructure of Copper, Brass, &c."

Percy F. Frankland. T. Slater Price.
C. F. Baker. T. Goode Joyce.
D. R. Boyd.

Loewenthal, Oscar,

Mill Hill Park, London, W.

Student in Chemistry. Student in Chemistry at the University of Geneva.

C. Graebe.
C. A. Buckmaster.
Frank E. Weston.
R. H. Aders.
W. Pullinger.
J. Wertheimer.

Mees, Charles Edward Kenneth,

33, St. Saviour's Road, Croydon.

Student in the Chemical Department of University College, London. Passed Intermediate Examination in Science. Reading for B.Sc. (Honours) Examination at the London University.

M. W. Travers.
Charles M. Stuart.
Edward C. Cyril Baly.
Lionel M. Jones.
William Ramsay.

Murphy, Albert John,

Preston House, Leeds.

Consulting Brewing Chemist. Trained for Moravian ministry; late Assistant Master at Stamford Grammar School and Army Coaching School, Sevenoaks. Member of Council of Institutes of Brewing; of Publication Committee of Journal of these Institutes; of Society of Public Analysts; occasional contributor to Scientific Brewing Journals.

Arthur Smithells.
John Heron.
Arthur R. Ling.
H. M. Dawson.
John Heaton.
Alfred C. Chapman.

Neil, Arthur Theodore,

21, South Grove, Highgate, N.

Schoolmaster (Science Master, Sutton Valence School). Honours in the Natural Sciences Tripos, Cambridge; Chief Subject, Chemistry. Science Master, Sutton Valence School. Anxious to follow the progress of Chemistry.

W. J. Sell.
W. T. N. Spivey.
H. J. H. Fenton.
F. W. Dootson.
Henry Jackson.

Neumann, Edgar,

10, Randolph Crescent, Maida Vale, London, W.

At Messrs. Forbes, Abbott, and Lennard's Tar Distillery, Greenwich.

B.A. (Oxon), Ph.D. (Gottingen). The thesis was on the "Isomerism of Fenchene Derivatives."

D. H. Nagel. A. D. Hall.
A. F. Walden. William Ramsay.
A. M. Kellas.

Oldershaw, William,

Market Place, Nottingham.

Chemist. Engaged for upwards of 20 years in Analytical and Manufacturing Chemistry. Reasons for desiring admission to the Society, to attend when special papers or lectures are given; to have access to the Society's Library.

Leonard de Koningh. Will. F. Mawer.
Albert Ivatt. *R. H. Harland.*
W. Watson Will.

Peacock, Arthur,

Smithies Bridge House, Heckmondwike, Yorks.

Assistant Schoolmaster. B.Sc. (Vic. Univ.) Chemistry in Final. Four years in Chemical Laboratory, 2 in Physical Laboratory, and 2 in Geological Laboratory, Yorkshire College. Have taught Chemistry, Physics, and Mechanics, for which I am qualified under Board of Education Regulations.

Arthur Smithells. John McCrae.
Herbert Ingle. Harry M. Dawson.
A. V. C. Fenby. James Foulds.
Julius B. Cohen. T. W. Lockwood.

Robertson, William,

41, Rosenau Road, Battersea Park, S.W.

Science Teacher. Educated at Allan Glen's School, the Glasgow and West of Scotland Technical College, and Royal College of Science, London (Frank Hatton Prize Winner and Associate in Chemistry of First Class, 1896–99). At present demonstrating in Chemistry at the Royal College of Science and Wandsworth Technical Institute.

William A. Tilden. G. T. Morgan.
W. Palmer Wynne. A. Greeves.
M. O. Forster. Thomas Gray.

Robinson, William Hammond,

The Limes, Painswick Rd., Cheltenham.

Schoolmaster. Head of the Public Science Classes affiliated to the Cheltenham Grammar School. M.A. Oxford. First Class Honours in Final Honour School of Natural Science (Chemistry),

1889. Since this date I have been engaged in teaching science, as Univ. Extension Lecturer, and in Secondary and Technical Schools.

William Odling. W. W. Fisher.
V. H. Veley. J. E. Marsh.
John Watts.

Shepperson, William,

"Longfield," Great Missenden, Bucks.

Gentleman. Being interested in the Science and desirous of obtaining the Journal. Specially interested in the Chemistry and Physiology of Fats.

Samuel Rideal. John Attfield.
Otto Hehner. *W. T. Burgess.*
E. G. Clayton. *P. Gerald Sanford.*

Sherratt, Charles Edmund Shaw,

24, Argyll Road, Normacott, Staffs.

School Teacher and Works Analyst. Attended Science Classes at the Wedgwood Institute, Burslem, for 2 years, and the Longton Science Classes for 6 years, gaining many 1st Class Science Certificates, including Honours (Chemistry). Now Analyst to the Chatterley Whitfield Coal and Iron Company.

Edmund M. Rich. Bennett C. Polkinghorne.
George George. *Thos. J. Cheater.*
Geo. W. Burman.

Slefrig, Samuel,

18, Waterloo Road, Shepton Mallet, Som.

Science Master in a Public Secondary School (School of Science). B.Sc. Vict.—took Chemistry in Prelim. Inter. B.Sc. and Final B.Sc. after full 3 years' course in Prac. and Theoret. Chemistry at University College, Liverpool, under Prof. Campbell Brown, D.Sc., F.I.C., F.C.S. Associate, and late Technical Science Scholar (Chem. and Phys.), University College, Victoria University. Teacher of Chemistry for past 3 years in Schools of Science, under Board of Education, and Somerset County Council. Lecturer in Chemistry, Pupil Teacher Centre, Shepton Mallet, Som.

J. Campbell Brown. Charles A. Kohn.
T. Francis Rutter. *Herbert B. Stocks.*
W. Collingwood Williams.

Smith, Henry Ewing,

22, City Road, London, E.C.

Manufacturing Chemist, chiefly of alkaloidal preparations of opium, morphia, codeia, &c. Member (by examination) of the Pharmaceutical Society of Great Britain. Studied Chemistry under Professor Jamieson at the Technical College, Glasgow; then under Professor W. H. Perkin at Heriot-Watt College, Edinburgh; then under Professor Weber at Zurich for analytical work and investigation of alkaloids, and research thereon of a synthetic nature. Now partner in the firm of T. and H. Smith and Co., Manufacturing Chemists Edinburgh and London.

Paul Thomas White. *David Howard.*
Thos. Tyrer. *D. Lloyd Howard.*
Alfred Gordon Salamon. *Reginald G. Halstead.*

Smith, James,

14, Mersey Road, Aigburth, Liverpool.

Analytical Chemist. Engaged for seven years in general analytical work in the laboratory of Mr. G. Watson Gray, F.I.C., also studied Organic and Inorganic Chemistry under Dr. George Tate, F.I.C., F.C.S.

George Tate. Saml. Banner.
Thomas J. Roberts. *Charles A. Kohn.*
C. J. Head.

Stell, Samuel Fenton,

25, Henry Street, Keighley.

Teacher of Chemistry. Fifteen years Lecturer and Demonstrator in Chemistry, Day and Evening Classes, Technical College, Bradford.

Walter M. Gardner. A. B. Knaggs.
A. William Gilbody. S. F. Dufton.
G. W. Slatter.

Taylor, William Henry,

19, Shafton Road, Victoria Park Road, N.E.

Chemist to Messrs. Burroughs, Wellcome and Co. A.I.C. Certificated Student of Finsbury Technical College. For 1 year at University College, London. Eighteen months in present position. Working for Final B.Sc.

Raphael Meldola. Francis H. Carr.
William Ramsay. E. F. Harrison.
Harold Picton. *Frederick B. Power.*

Tozer, Herbert Ackerman,

113, Stepney Green, London, E.

Schoolmaster, London School Board. Bachelor of Arts, Univ. of London. I hold Advanced Certificate in Chemistry of Science and Art Department, also in Mathematics—three—and in Magnetism and Electricity. Am a Candidate for the B.Sc. Degree (Inter.) of

London University. Have been a student for two terms at University Tutorial College, Red Lion Square, under J. W. Shepherd, Esq., B.Sc., first in 1st Class Honours in Chemistry, and E. Catchpool, Esq., B.Sc., 1st Class Honours in Physics. I take a great interest in the progress of Chemical Science, and therefore wish to become a Fellow of the Chem. Soc. and to read its publications.

J. E. Johnson. *T. H. Dodd.*
R. J. Redding. *W. H. Deering.*
J. C. Aylan. *Oliver Trigger.*

Welch, George Edward,

88, Caledonian Road, Leeds.

Science Master. B.Sc., London. Bracketed 1st in 1st Class Honours Prac. Chem., South Kensington. Six and a half years Teacher of Chem. at Bablake School, Coventry. Six years Teacher of Chem. and Physics, Middle Class School, Leeds.

William G. Boul. E. J. Cox.
Thomas Turner. Julius B. Cohen.
Reginald B. Brown.

Wylie, Adam Storer,

93, Manchester Street, Oldham.

Analyst at the Oldham Corporation Sewage Works. Have been employed as Analyst on the Oldham Corporation Sewage Works during the past four years, and have had sole control of between four and five acres of bacteria beds (at present, I believe, the largest area in England). Issued report to the Corporation on the purification of sewage and working of bacteria beds in 1900.

Francis Jones. Frank Scudder.
Percy F. Frankland. Robert Pettigrew.
Gilbert J. Fowler. *W. H. Perkin.*

The following Certificate was authorised by Council under bye-law I (3):

Verteuil, Joseph de,

Clarence Street, Port of Spain, Trinidad, B.W.I.

Assistant Analyst, Government Laboratory, Trinidad. Student, St. Mary's College, Trinidad, 1½ years; Student, Stoneyhurst College, England, 5 years; Student, Institut Beauvais, France, 3 years. Obtained Diploma, "Ingénieur Agricole," Institut Beauvais. Chemist at Orange Grove Sugar Factory, 1 year; Chemist at Esperanza Sugar Factory, 1 year; Assistant Analyst, Government Laboratory, Trinidad, 1 year.

P. Carmody.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

Issued 9/5/1901

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 237.

May 2nd, 1901. Professor Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

Messrs. Storr and Talbot were formally admitted Fellows of the Society.

The following certificates were read for the first time: Ormsby Gore Adams, Stawell, Victoria; Joseph Samuel Bridges, 45, Thistlewaite Road, Clapton, N.E.; Adolf Ludwig Ferdinand Lehmann, Bangalore, Mysore, India; William Lowson, 83, Kyrle Road, Clapham Common, S.W.; James Bertram Russell, 356, Padiham Road, Burnley; Thomas Sandford, 2, Market Place, Ulverston; Samuel Edward Sheppard, Ravensmere, Bromley Road, Catford, S.E.; Andrew Biggam Smith, Queenstown, Cape Colony; George William Gerald Tatam, Mercers' Hall, Cheapside, E.C.; James Whittle, 30, Bridge Street, Morpeth.

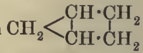
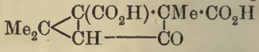
A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:—Messrs. William C. Anderson, M.A., D.Sc.; George Stanfield Blake; Edward Richards Bolton; Edward G. P. Bousfield; Percival J. Burgess, M.A.; William Carter; Ernest Clark, B.Sc.; Thomas Kennedy Cockburn; Eustace Coddington, B.A.; Walter Stevens Crocker; Henry Drysdale Dakin; Raymond Dubois, B.Sc.; William Henry Duckworth; Albert Ernest Dunstan, B.Sc.; Samuel Philip Eastick; Hugh Edward Ellis; John Vargas Eyre; John Hanley; John A. Harrison, B.Sc.; Francis R. Henley, B.A.; Henry Herbert Higgs, B.Sc.; Alfred James Hyder; William

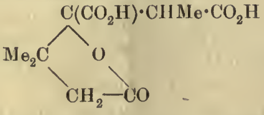
Henry C. Jemmett, B.A.; Ernest Alfred Lewis; Oscar Loewenthal; Alex. McKenzie, M.A., Ph.D., D.Sc.; Charles Edward Kenneth Mees; Albert John Murphy; Arthur Theodore Neil, B.A.; Edgar Neumann, B.A., Ph.D.; William Oldershaw; Arthur Peacock, B.Sc.; William Robertson; William Hammond Robinson, M.A.; William Shepperson; C. Edmund Shaw Sherratt; Samuel Slefrig, B.Sc.; Henry Ewing Smith; James Smith; Samuel Fenton Stell; William Henry Taylor; Herbert Ackerman Tozer, B.A.; Joseph De Verteuil; George Edward Welch, B.Sc.; Adam Storer Wylie.

Professor Armstrong requested that the abstract of Professor Perkin's paper might be read, and suggested that it might be desirable to arrange for accounts to be given by persons specially selected of the work of authors who were unable to be present in person.

Of the following papers, those marked * were read.

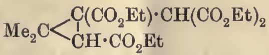
*74. "The synthetical formation of bridged-rings. Part I. Some derivatives of bicyclopentane." By W. H. Perkin, jun., and J. F. Thorpe.

In a paper recently published, Baeyer (*Ber.*, 1901, **33**, 3771) has developed a system of nomenclature for bridged-rings and their derivatives. According to this system, the hydrocarbon  $CH_2<\begin{matrix}CH\cdot CH_2\\ |\quad\ \ |\\ CH\cdot CH_2\end{matrix}$ is named *bicyclopentane*, and the acid  $Me_2C<\begin{matrix}C(CO_2H)\cdot CMe\cdot CO_2H\\ |\qquad\qquad\quad |\\ CH\text{———}CO\end{matrix}$ previously described (*Proc.*, 1900, **16**, 151) is therefore *trimethylketobicyclopentanedicarboxylic acid.* It has already been stated that this acid, when digested with potash, is converted into an acid melting at 237°, and it has since been found that the latter yields an anhydride (m. p. 96°) which on distillation is converted into the anhydride (m. p. 131°) of an isomeric acid melting at 181°. Careful investigation has shown that these acids, which are evidently stereoisomeric, are not furfuran derivatives, as was at first supposed, but are *lactones* of *trimethylhydroxybutanetricarboxylic acid,*



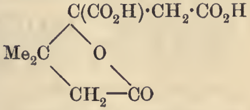
,

disruption of the whole bicyclopentane ring having taken place during their formation. A somewhat similar decomposition is shown by *ethyl dimethyldicarboxytrimethylenemalonate,*

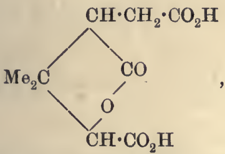


$$\mathrm{Me_2C}\Big<\begin{matrix}\mathrm{C(CO_2Et)\cdot CH(CO_2Et)_2}\\ |\\ \mathrm{CH\cdot CO_2Et}\end{matrix}$$

(*loc. cit.*, p. 149), which on hydrolysis with alcoholic potash yields two acids melting at 187° (not 176° as previously stated) and 158°. These acids have now been shown to be the *lactones* of the two isomeric *dimethylhydroxybutanetricarboxylic acids,*

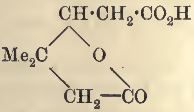


and

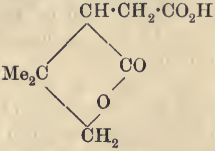


, the trimethylene ring having been broken during hydrolysis; but unfortunately so far it has not been possible to decide which formula belongs to the former and which to the latter of the two acids.

Both acids on heating lose carbon dioxide, and are converted into the *lactones* of two isomeric *dimethylhydroxybutanedicarboxylic acids* probably

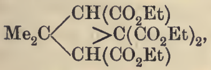


and



that from the acid of melting point 187° melts at 108°, and that from the acid of melting point 158° at 154°.

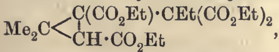
During the investigation of the bicyclopentane derivatives, it became necessary to prove conclusively that ethyl dimethyldicarboxytrimethylenemalonate really had the constitution assigned to it above, and that it was not a tetramethylene derivative of the formula



$$\mathrm{Me_2C}\Big<\begin{matrix}\mathrm{CH(CO_2Et)}\\ \\ \mathrm{CH(CO_2Et)}\end{matrix}\Big>\mathrm{C(CO_2Et)_2}$$

, which was the only other possibility.

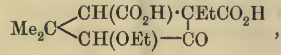
This was done by treating the ester with sodium ethylate and ethyl iodide, when it yielded *ethyl dimethylethyldicarboxytrimethylenemalonate,*



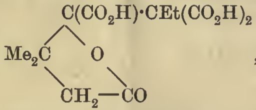
$$\mathrm{Me_2C}\Big<\begin{matrix}\mathrm{C(CO_2Et)\cdot CEt(CO_2Et)_2}\\ |\\ \mathrm{CH\cdot CO_2Et}\end{matrix}$$

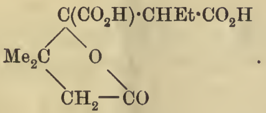
, a colourless oil boiling at 230—232° (30 mm.). The formation of this ethyl derivative shows that the original ester must have contained a hydrogen atom replaceable by sodium, and the tetramethylene formula given above is therefore excluded.

When this ethyl substitution product is digested with alcoholic potash, it yields a dibasic acid (m. p. 175°) which is probably *dimethylethylethoxyketopentamethylenedicarboxylic acid*,



$$\mathrm{Me_2C}\!<\!\begin{matrix}\mathrm{CH(CO_2H)\cdot CEtCO_2H}\\ \mathrm{CH(OEt)-CO}\end{matrix}\ ,$$

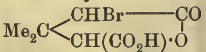
and there is formed, at the same time, a tribasic lactonic acid melting at 193°, which is probably the *lactone* of *dimethylethylhydroxybutanetetracarboxylic acid*,  , and a dibasic lactonic acid melting at 213°, which is probably the *trans*-modification of *dimethylethylhydroxybutanetricarboxylic acid*,



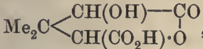
The corresponding *cis*-modification, which is obtained by the action of hydrochloric acid on the dimethylethylethoxyketopentamethylenedicarboxylic acid mentioned above, melts at 144°, and gives an anhydride melting at 168°.

The ease with which disruption of the trimethylene ring takes place in the formation of these lactones is very remarkable; the only other similar case which is known is that described by Buchner and Witter (*Ber.*, 1894, 27, 871).

During the course of the investigation of the bicyclopentane derivatives, some interesting derivatives of *ββ-dimethylglutaric acid*, $\mathrm{CO_2H\cdot CH_2\cdot CMe_2\cdot CH_2\cdot CO_2H}$, have been prepared and examined, and the results may be briefly summarised as follows:—

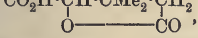
$\alpha\alpha_1$-Dibromodimethylglutaric acid, $\mathrm{CO_2H\cdot CHBr\cdot CMe_2\cdot CHBr\cdot CO_2H}$, is obtained on treating dimethylglutaric anhydride with phosphorus pentachloride and bromine and digesting the product with anhydrous formic acid; it melts at 187—189°, and when treated with pyridine or boiled with water it yields the lactone of *α-bromo-α_1-hydroxydimethylglutaric acid*,  $\mathrm{Me_2C}\!<\!\begin{matrix}\mathrm{CHBr-CO}\\ \mathrm{CH(CO_2H)\cdot O}\end{matrix}$. This melts at 169—170°, gives an ethyl ester boiling at 201° (45 mm.), and is characterised by the great stability of its bromine atom which is not removed even by

boiling with silver nitrate and nitric acid. Strong potash, however, converts it into the *lactone* of *aa_1-dihydroxydimethylglutaric acid*,



$Me_2C<\begin{matrix}CH(OH)—CO\\ CH(CO_2H)\cdot O\end{matrix}$, which melts at 142°.

During the bromination of dimethylglutaric acid, a small quantity of *aa-dibromodimethylglutaric acid*, $CO_2H\cdot CBr_2\cdot CMe_2\cdot CH_2\cdot CO_2H$, is formed, and this, on boiling with sodium carbonate, yields *aa-dihydroxydimethylglutaric acid*, $CO_2H\cdot C(OH)_2\cdot CMe_2\cdot CH_2\cdot CO_2H$, which melts at 84° and behaves in many of its reactions as the keto-acid, $CO_2H\cdot CO\cdot CMe_2\cdot CH_2\cdot CO_2H$, containing 1 molecule of water less. Thus it combines with *o*-toluylenediamine, and on reduction with sodium amalgam is converted into the lactone of *a-hydroxydimethylglutaric acid*,



$\begin{matrix}CO_2H\cdot CH\cdot CMe_2\cdot CH_2\\ O—————CO\end{matrix}$, which melts at 112°, and has already been described (*Trans.*, 1899, **75**, 56).

*75. "Lead silicates in relation to pottery manufacture."

By T. E. Thorpe, C.B., F.R.S., and C. Simmonds, B.Sc.

As is well known, the use of oxides and basic carbonates of lead in glazes employed by potters is attended with danger to the health of the workpeople on account of the ready solubility of these compounds in the acids of the animal organism. Attention was drawn to the fact that lead silicates or boro-silicates, or complex silicates of lead and other metals, can be used instead of the oxides or carbonates as a means of introducing lead into the glaze. On the Continent this use of lead silicates is far more common than in England, and it is generally recognised that their employment has greatly tended to minimise the risk of lead-poisoning. This is due to the fact that the lead silicates used in the continental factories are of a high degree of insolubility so far as the lead is concerned.

On examining a number of lead silicates used or proposed for use in England, it was found that many were attacked by dilute acids practically to the same extent as the oxides or carbonates. That is, they yielded the whole, or nearly the whole, of their lead to the action of acids comparable with the acids found in the human system—such as, for example, the hydrochloric acid of the gastric juice. Other specimens were more resistant, but still yielded a large proportion of their lead. On the other hand, the specimens obtained from the Continent, as well as many which have recently been produced by English manufacturers, gave up only small quantities of lead when tested under the special conditions described.

A large number of specimens was therefore analysed in order to ascertain, if possible, to what variations in chemical composition these differences of behaviour were due.

The condition on which the insolubility of the lead depends was found to be, primarily, the existence of a certain ratio between the whole of the base-oxides on the one hand, and the whole of the acid-oxides on the other. This becomes eventually referable to the hypothetical silicic acids from which the silicates may be considered to be derived. For working purposes, the relation may be more simply expressed as

$$\frac{\text{sum of percentages of base oxides, expressed as PbO}}{\text{sum of percentages of acid-oxides, expressed as SiO}_2},$$

or, alternatively, as

$$\frac{\text{number of acid molecules}}{\text{number of base molecules}},$$

the latter ratio being obtained by dividing the percentage of each oxide by its molecular weight, and then dividing the sum of the quotients for the acid-oxides by the sum of the quotients for the base-oxides.

Provided the ratio falls within certain definite limits, the amount of lead extracted under the prescribed conditions is always small. It does not depend upon the quantity of lead in the silicate, which may have any value up to 50 or 55 per cent. The other bases usually present (lime, alumina, and alkalis) may also vary considerably, replacing one another, and also the lead oxide, within very wide limits without prejudice to the insolubility of the lead.

Analyses and formulæ of a number of silicates were given, together with tables showing the dependence of the solubility of the lead in the silicates upon the ratios mentioned above.

DISCUSSION.

Mr. F. J. **LLOYD** asked whether experiments had been made using smaller quantities of solution than 1000 parts to 1 part of substance. The acid present in 1000 c.c. would be about seven times as much as that required to dissolve 1 gram of lead oxide. The conditions which influenced the solubility of substances in dilute acid solutions were of especial interest to agricultural chemists. He had found in some experiments that the volume of solution employed appeared to materially affect the solubility, and wished to know whether the authors had had a similar experience during their investigation.

Prof. **TILDEN** enquired whether the authors had paid special attention to the degree of fineness of the powders submitted to the action of the acid. Some facts had already been published which seemed to show that the apparent solubility of a frit was seriously influenced by the amount of trituration to which the substance had been subjected before bringing it into contact with the acid.

Professor **Clowes** said it would be of interest to know if the solvent action of acids other than hydrochloric acid had been tried, and with what results. He also asked whether the method of testing finished articles purporting to be covered with leadless glaze, by exposing them to the action of dilute hydrochloric acid for some time and examining the solution for the presence of lead, was satisfactory, and what were the best conditions for applying such a test.

Mr. **Elworthy** asked whether the authors had estimated the solubility of the frits or glazes in salt solutions, as they were much more likely to come into contact with salt solution than with free hydrochloric acid, especially during the preparation of food, and whether the lead dissolved from the frit existed in the solution as chloride or as a soluble silicate.

Prof. **Carmody** asked whether any comparisons had been made between the amount of lead oxide soluble in the frits before and after their application.

Mr. **Simmonds**, in reply, stated that an excess of acid was necessary, for otherwise misleading results were obtained; this was due to the curious fact that certain kinds of lead silicate reacted with a neutral solution of lead chloride and removed the lead from solution, probably as an insoluble oxychloride. The volume of acid selected must be sufficiently great to ensure that there should be no very considerable weakening of its strength by the action of the various acid-neutralising constituents, of which, it should be borne in mind, there might be several besides the lead.

As regards fineness of subdivision, some of the specimens were sent ready ground, and were stated by the manufacturers to be in the condition in which they were to be used for glazing pottery ware; these were tested as received. The other specimens were ground to an impalpable powder in an agate mortar. Various solvents had been experimented with—for example, lactic and acetic acids—but the results threw no greater light on the subject than those obtained with hydrochloric acid; consequently, the experiments were not persisted in. Salt solution had not been tried. He did not know whether testing the glaze on table ware with hydrochloric acid had been suggested, but in Germany there was a provision that such ware should not give up lead when boiled for half an hour with 4 per cent. acetic acid.

With reference to the state in which the lead existed when dissolved from a silicate, whether as a lead silicate or as lead chloride, complete analyses of several of the solutions had been made, and some small quantity of silica was always present. The lead, or a part of it, may therefore, perhaps, have dissolved as a basic silicate.

76. "The preparation and properties of 2:6-dibromo-4-nitrosophenol." By M. O. Forster and W. Robertson.

2 : 6-Dibromo-4-nitrosophenol is produced by the action of potassium hypobromite on *p*-nitrosophenol dissolved in potassium hydroxide solution (compare Fischer and Hepp, *Ber.*, 1888, **21**, 674); the *potassium*, *acetyl*, and *benzoyl* derivatives are well defined. Dilute nitric acid oxidises the substance to 2 : 6-dibromo-4-nitrophenol, but the concentrated acid converts it into 2-bromo-4 : 6-dinitrophenol. Tin and hydrochloric acid reduce 2 : 6-dibromo-4-nitrosophenol to 2 : 6-dibromo-4-aminophenol, of which the *benzoyl* derivative is well defined.

77. "The chlorination of toluene." By W. P. Wynne.

In consequence of the publication of an abstract of a paper by Cohen and Dakin (p. 91), the author wishes to state that he has been, and is, engaged in a study of the chloro-derivatives obtained in chlorinating toluene under Seelig's conditions (*Trans.*, 1892, **61**, 1051). The six dichlorotoluenes, and their sulphonic acids, chlorides, and amides, to which Cohen and Dakin refer, were prepared and examined in this connection (*loc. cit.*, p. 1042; Wynne and Greeves, *Proc.*, 1895, **11**, 151). Moreover, the 2 : 5-dichlorotoluene, which these authors state is very probably formed in presence of the mercury-aluminium couple, has been recognised as present in considerable quantity in the mixture of dichlorotoluenes obtained by Seelig's method.

ERRATA.

Page	Line	
94	18	*after* "place" *insert* "by further dissociation."
94	20	*for* "subvalent" *read* "subunivalent."

At the next ordinary meeting, on Thursday, May 16th, the following papers will be communicated :—

"The nutrition of yeast. Part III." By A. L. Stern, D.Sc.

"Derivatives of methylfurfural." By H. J. H. Fenton and Miss Mildred Gostling.

"The preparation and optical inversion of optically active nitrogen compounds; dextro- and lævo *α*-benzylphenylallylmethylammonium salts." By W. J. Pope and A. W. Harvey.

RICHARD CLAY AND SONS LIMITED, LONDON AND BUNGAY.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 238.

Extraordinary General Meeting, May 15th, 1901. Professor EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

The PRESIDENT stated that this Meeting had been convened in accordance with a requisition, signed by 66 Fellows of the Society, to consider the decision of the Council to hold the Ordinary Meetings of the Society during the ensuing session on Wednesdays at 5.30 p.m.

After a discussion in which, amongst others, the following Fellows took part: Dr. Lewkowitsch, Dr. Moody, Mr. A. G. Bloxam, Mr. Cassal, Dr. Armstrong, Mr. Hehner, Mr. Tyrer, Mr. Pakes, Prof. Tilden, Prof. Ramsay, Dr. Crossley, Dr. Forster, Prof. Dewar, and Mr. F. J. Lloyd,

Dr. ARMSTRONG moved and Mr. HEHNER seconded the following resolution:—

"That in the opinion of this Meeting the change proposed in the day and hour of Meeting will prevent the attendance of a large proportion of the junior and other Fellows who have hitherto been regular attendants; that the said change is contrary to the best interests of the Society, and that it is desirable that the question be reconsidered by the Council."

The resolution was declared by the President to be carried. The numbers being asked for, a division was taken, with the following result:—For the resolution, 92; against, 3. A certain number of Fellows abstained from voting.

May 16th, 1901. Professor **Emerson Reynolds**, Sc.D., F.R.S., President, in the Chair.

Messrs. McKenzie, Ferguson, Woodbridge, Robertson, Jennings, Dodd, Neil, Mees, Wayland, and Dixon were formally admitted Fellows of the Society.

The following certificates were read for the first time:—Hubert Haigh Barker, 3, Waverley Place, St. John's Wood, N.W.; George Dean, 2, Scriven Grove, Knaresborough; Thomas Henry James Eling, 32, Hill Top Avenue, Shepherd's Lane, Leeds; Edward Kenneth Hanson, Hadley Wood, N.; Frederick Thomas Harry, 106, Sandmere Road, Clapham, S.W.; Edward Horton, 8, Orford Street, Chelsea, S.W.; Christopher George Kiddell, 24, Queen's Gardens, Muswell Hill, N.; Robert Tabor Lattey, Trinity College, Oxford; F. G. Macdonald, Government Laboratory, Durban; Frank Oram, Market Place, Romsey; John Edward Purvis, University Chemical Laboratory, Cambridge; Gerald Theodore Sylvester Sichel, R.N. Hospital, Haslar, Gosport; Duncan Randolph Wilson, Magdalen College, Oxford.

The **President** read the resolution passed at the Extraordinary General Meeting (*see* p. 117) which he stated had been that afternoon brought before the Council, by whom it was being carefully considered.

Dr. **Armstrong**, referring to the ruling given by the President at the previous meeting that a paper read in the absence of the author could not be discussed, drew attention to Bye-law XIV, and contended that this bye-law expressly provided that every paper communicated to the Society should be open to discussion. He stated that during the whole course of his experience, extending over 30 years, it had always been the practice of the Society, when the occasion arose, to discuss papers read in the absence of their authors.

Dr. **Perkin**, in reply to a question by Dr. Armstrong, said that in the past papers had often been discussed in the absence of their authors.

Dr. **Divers** said that having been resident in Japan when most of his papers were sent to the Society, he had always been willing that they should be discussed.

Prof. **Dunstan** pointed out that Bye-law XIV evidently supposed that authors would be present to read their papers, and its directions could not be literally followed at the present time. In these matters, however, the Bye-law gave large discretion to the chairman.

Mr. W. P. **Bloxam** asked whether it was within the power of the President to closure or prevent discussion on any paper read to the Society.

The PRESIDENT replied that as a general rule he should not think of doing so.

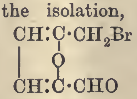
Mr. BLOXAM remarked that probably Dr. Armstrong would recollect when he read a paper on ammonium sulphides, Dr. Armstrong, as President, had prevented any discussion whatever on that paper.

The PRESIDENT considered that the Bye-law read by Dr. Armstrong assumed the presence of the author at the meeting. Criticism on a mere abstract in the author's absence, and without his assent, seemed contrary to the fair general principle which governed most public meetings. On the other hand, he saw no objection to questions relating to points of nomenclature or detail which could be elucidated by reference to the original paper, should the latter be available at the time.

Dr. ARMSTRONG said that such being the President's opinion, and as he could not accept the ruling as correct, it would be necessary for him to raise the question again elsewhere.

Of the following papers, those marked * were read.

*78. "Derivatives of methylfurfural." By H. J. H. Fenton and Miss M. Gostling.

The authors have already (*Trans.*, 1898, **73**, 554; 1899, **75**, 423; 1901, **79**, 361) described the isolation, properties, and constitution of bromomethylfurfural,  , a well defined, crystalline substance melting at 60° which gives rise to remarkable colour reactions. Because of the interest which attaches to this compound owing to its relations with the carbohydrates and the bearing of its formation on questions in plant physiology, it was considered desirable to make a further study of the compound and its derivatives. The following new compounds were described:

Chloromethylfurfural, m. p. 36—37°; *acetoxy*-derivative, m. p. 55°; *benzoxy*-derivative, m. p. 56—57°; *difurfuryl-ethane-dialdehyde*, m. p. 119—120°; with its corresponding *dihydrazone*, m. p. 179—181°; *dicarboxylic acid*, m. p. 267—269°; and *dioxime*, m. p. 182°. A very simple method of obtaining pure methylfurfural was also described.

DISCUSSION.

Mr. W. J. POPE asked whether bromomethylfurfural, which contains a bromine atom and an ethereal oxygen atom attached to adjacent carbon atoms, was capable of condensing with alkyl sulphides or tertiary amines to yield sulphonium or quaternary ammonium derivatives.

Mr. Fenton, in reply, said that both the chloro- and the bromo-derivatives of methylfurfural readily interacted with various amines.

*79. "Optically active nitrogen compounds and their bearing on the valency of nitrogen; dextro- and lævo-α-benzylphenylallylmethylammonium salts." By W. J. Pope and A. W. Harvey.

The authors have prepared in a state of purity a number of substances owing their optical activity to the presence of an asymmetric pentad nitrogen atom.

The externally compensated α-benzylphenylallylmethylammonium iodide of Wedekind when treated with silver *d*-camphorsulphonate yields *d*-benzylphenylallylmethylammonium *d*-camphorsulphonate, which melts at 171—173° and has the molecular rotation $[M]_D = +218 \cdot 1°$ in an aqueous solution containing one-fifth of a gram-molecule per litre; whence the value for the *d*-benzylphenylallylmethylammonium ion is $[M]_D = +166 \cdot 4°$. The residue from the preparation of this salt, when treated in aqueous solution with potassium iodide yields crude *l*-benzylphenylallylmethylammonium iodide which, on treatment with silver *l*-camphorsulphonate, gives the new salt, l-*benzylphenylallylmethylammonium* l-*camphorsulphonate.* This melts at 171—173° and has the molecular rotation $[M]_D = -210 \cdot 6°$ in an aqueous solution containing one-fourth of a gram-molecule per litre; the molecular rotation $[M]_D = -159 \cdot 0°$, is thence deduced for the ion of the *l*-base.

These salts when treated with potassium iodide in aqueous solution give crystalline precipitates of the corresponding iodides which may be crystallised from alcohol without undergoing inversion; they are soluble in cold chloroform, and in this solvent have the specific rotations $[\alpha]_D = +55 \cdot 2°$ and $[\alpha]_D = -53 \cdot 4°$ respectively. On warming the chloroform solutions, the rotation rapidly vanishes and a similar result is attained on allowing the cold chloroform solutions to stand for three days; the solutions on evaporation yield the externally compensated iodide in a state of purity, so that the inversion may be attributed to a dissociation into tertiary base and benzyl iodide.

The bromides are prepared in a similar manner and have the specific rotations $[\alpha]_D = +64 \cdot 1°$ and $[\alpha]_D = -65 \cdot 0°$ respectively in cold chloroform; the salts undergo inversion in chloroform just as the iodides do although appreciably less rapidly.

d-*Benzylphenylallylmethylammonium nitrate,*

$$C_7H_7 \cdot N(C_6H_5)(C_3H_5)(CH_3)NO_3,$$

is a colourless crystalline substance melting at 164—165°, and in aqueous solution has the molecular rotation $[M]_D = +165 \cdot 3°$, a value comparing well with that of the ion of the *d*-base deduced from the examination of the *d*-camphorsulphonate.

d-*Benzylphenylallylmethylammonium mercuri-iodide*,

$C_7H_7{\cdot}N(C_6H_5)(C_3H_5)(CH_3)I,HgI_2$,

is obtained as a bright yellow crystalline compound by heating the pure *d*-iodide with one equivalent of mercuric iodide in ethyl acetate solution; it melts at 125—127° and has the specific rotation $[\alpha]_D = +24{\cdot}4°$ in ethyl acetate solution. The enantiomorphously related salt also melts at 125—127°, and has the specific rotation $[\alpha]_D = -23{\cdot}0°$ in ethyl acetate. It is concluded that these mercuri-iodides contain quinquevalent nitrogen.

Attention was drawn to the persistency of the optical activity of these asymmetric nitrogen compounds except under the specific conditions which cause inversion. It should be noted that these substances are fundamentally distinguished from asymmetric carbon compounds in that they are electrolytes which, in aqueous solution, must be supposed to undergo electrolytic dissociation, giving an optically active ion of which the disrupted valency is one of those attached to the asymmetric atom; yet even under these conditions no inversion takes place.

Discussion.

Dr. Armstrong said that when Messrs. Pope and Peachey first stated that they had succeeded in obtaining optically active nitrogen compounds, he had pointed out that the discovery was of special importance, because it seemed at last to afford a means of deciding the long standing dispute as to the valency of nitrogen in the ammonium compounds. The discovery was not in itself sufficient to disprove the molecular hypothesis advocated by Kekulé, as it was possible to formulate the ammonium salts as molecular compounds, which it was conceivable might have a tetrahedral configuration. But the subsequent discovery of optically active sulphur compounds by Messrs. Pope and Peachey might be regarded as complete disproof of the molecular compound hypothesis, and it was consequently legitimate to argue that nitrogen acted as a pentad in the ammonium compounds. Nevertheless, there could be little doubt that the "superior" valency assumed by nitrogen in the ammonium compounds and by sulphur in the sulphonium compounds was in some way different in character from the lower or ordinary valency of these elements: that it was a "conditional" valency, as nitrogen became pentad and sulphur tetrad only under special conditions and in a very limited number of cases. There could be little doubt that the direction in which valency could act was of importance, and the inquiry into this must play an important part in the future. Reference was made to the behaviour of sulphur in thiophen as affording proof that the superior valency in some way became masked by the inclusion of the sulphur in the ring. The use made by the authors of the behaviour of double mercuric and platinic compounds as arguments against a change in valency was of a most ingenious character, as was also the reference to the evidence afforded by the stability of the active salts against the ionic dissociation hypothesis: the suggestion that a free affinity could not well act "materially" and serve to condition optical activity was particularly worthy of note.

Dr. HEWITT referred to Mr. Pope's remarks on the fact that the addition of mercuric iodide to optically active quaternary ammonium iodides gives rise to double salts in which the optical activity is preserved, and the conclusion drawn that the valency of nitrogen remains unchanged, and the extension of this argument to the valency of sulphur in the compounds of sulphonium iodides with metallic iodides. He considered it possible that the two active forms of a sulphonium iodide might add on mercuric iodide, the sulphur atom becoming hexavalent, and nevertheless the two resulting octahedral formulæ be related to one another as an object is to its image.

Dr. FORSTER suggested that the numerical difference between the rotation constants of *d*A*d*B and *l*A*l*B might disappear if *l*A*l*B were separated first, by adding *l*-camphorsulphonate to the racemic mixture, and inquired whether *l*-bromocamphorsulphonic acid would not be a useful substitute for *l*-camphorsulphonic acid. He questioned whether racemisation of the active ammonium iodide is due to dissociation on the lines indicated by Mr. Pope, pointing out that addition of ammonia should accelerate the change. Referring to the principle that a change of valency involves an alteration in the original valency directions, he wished to know why, if divalent sulphur forming part of a ring is prevented from becoming tetravalent on account of this principle, nitrogen does not lie under the same disability.

Dr. H. MCKENZIE asked whether Mr. Pope had had occasion to confirm Le Bel's resolution of inactive methylethylpropylisobutylammonium chloride by means of *Penicillium glaucum*; and, further, whether he had attempted to resolve Le Bel's substance by aid of an optically active acid, such as α-bromocamphorsulphonic acid.

Dr. MORGAN, in supporting the view that the nitrogen in the ring systems of the pyridine and acridine types is generally capable of assuming the quinquevalent condition, recalled the fact that naphthacridine readily combines with alkyl iodides yielding quaternary iodides so stable that they can be crystallised from hot aniline without decomposition, indicating thereby that the cyclic nitrogen is able to maintain its quinquevalency, even in the presence of an amine containing a nitrogen atom free from constraint as regards the direction of its linkings.

Mr. W. J. Pope, in reply, observed that the new principle brought forward, namely, that during change of valency of an atom the valency directions might also change, appeared to be applicable when a bi- or quadri-valent sulphur atom became quadri- or sexa-valent respectively or when a quinquevalent nitrogen atom became septavalent; it is not necessarily applicable to the case of a tervalent nitrogen atom becoming quinquevalent because such a change might be effected by the two fresh groups attaching themselves to the nitrogen atom along a direction perpendicular to the plane containing the original three groups. The principle derived support from the fact that bivalent sulphur contained in a closed ring, and consequently restrained from altering its environment, cannot be caused to combine with alkyl iodides and become quadrivalent; the *n*-alkyl derivatives of piperidine and tetrahydroquinoline, on the other hand, combine with alkyl iodides at least as readily as do tertiary bases in which the nitrogen atom is not contained in a closed ring. *d*-Benzylphenylallylmethylammonium iodide undergoes inversion in chloroform solution about twice as rapidly as the corresponding bromide, but no experiments have yet been made with other salts. It is not immediately apparent how the inversion of optically active stannomethyl derivatives can be caused by dissociation, but the inversion is possibly due to dissociation of the stannic compound into a stannous compound and an alkyl salt.

*80. "Reactions of hydroxyoxamides." By R. H. Pickard and W. Carter.

Hydroxyoxamide and its mono-phenyl-, *p*-tolyl-, α- and β-naphthyl-derivatives, RNH·CO·CONHOH, react as hydroxamic acids. The general reactions of hydroxamic acids (Thiele and Pickard, *Ann.*, 1899, **309**, 189) can be carried out with these compounds, giving quantitative yields of substituted biurets, carbonyl di-carbamides, and allophanates.

The monosubstituted phenyl-, *p*-tolyl-, α- and β-naphthyl-biurets, analogously substituted ethyl allophanates, and the *sym*-disubstituted carbonyl di-carbamides, $CO(NHCONHR)_2$, were described.

The acetate of oxalodihydroxamic acid described by Hantzsch (*Ber.*, 1894, **27**, 801), is apparently a diacetate; it is acid in properties, and dissolves in a solution of sodium carbonate, giving a solution which, after warming, contains small quantities of hydrazine.

*81. "The *sym*-trichlorobromoanilines; and chloro- and bromo-amino-derivatives of chlorobromoacetanilides." By F. D. Chattaway and K. J. P. Orton.

The authors called attention to the great resemblance existing between the two similarly constituted *sym*-chlorodibromoanilines and their acetyl derivatives respectively. There is a similar resemblance between the two *sym*-dichlorobromoanilines. The acetylchloroamino-derivatives, however, serve to distinguish the one isomeric aniline from the other, as they possess melting points lying several degrees apart.

The following compounds have been prepared: 4-*chloro*-2 : 6-*dibromoaniline*, $C_6H_2ClBr_2\cdot NH_2$ (first prepared by Hofmann, *Ann.*, 1845, **53**, 38), needles, melting at 97° (Hofmann does not record the melting point) and boiling at 301° under 760 mm. pressure; 4-*chloro*-2 : 6-*dibromoacetanilide*, $C_6H_2ClBr_2\cdot NHAc$, flattened prisms or needles, melting at 226—227°; *acetylchloroamino-4-chloro*-2 : 6-*dibromobenzene*, $C_6H_2ClBr_2\cdot NClAc$, short, four-sided prisms melting at 110—111°; 2-*chloro*-4 : 6-*dibromoaniline*, $C_6H_2ClBr_2\cdot NH_2$ (first prepared by Langer, *Ann.*, 1882, **215**, 115), needles, closely resembling the isomeric aniline and melting at 95°; 2-*chloro*-4 : 6-*dibromoacetanilide*, $C_6H_2ClBr_2\cdot NHAc$, flattened prisms or needles, melting at 227°; *acetylchloroamino-2-chloro*-4 : 6-*dibromobenzene*, $C_6H_2ClBr_2\cdot NClAc$, four-sided prisms, melting at 99—100°; 2 : 6-*dichloro-4-bromoaniline*, $C_6H_2Cl_2Br\cdot NH_2$ (first prepared by Fittig and Büchner, *Ann.*, 1877, **188**, 22), needles, melting at 92° (Fittig and Büchner give 93·5°); 2 : 6-*dichloro-4-bromoacetanilide*, $C_6H_2Cl_2Br\cdot NHAc$, flattened prisms or needles melting at 214°; *acetyl chloroamino*-2 : 6-*dichloro-4-bromobenzene*, $C_6H_2Cl_2Br\cdot NClAc$, prisms melting at 81°; 2 : 4-*dichloro-6-bromoaniline*, $C_6H_2Cl_2Br\cdot NH_2$, needles melting at 83·5°; 2 : 4-*dichloro-6-bromoacetanilide*, $C_6H_2Cl_2Br\cdot NHAc$, flattened prisms or needles melting at 218°; *acetylchloroamino*-2 : 4-*dichloro-6-bromobenzene*, $C_6H_2Cl_2Br\cdot NClAc$, four-sided prisms melting at 91—92°; 2 : 6-*dibromoacetanilide*, $C_6H_3Br_2\cdot NHAc$, prisms melting at 208—209°; *acetylchloroamino*-2 : 6-*dibromobenzene*, $C_6H_3Br_2\cdot NClAc$, short prisms melting at 88°; *acetylbromoamino-4-chlorobenzene*, $C_6H_4Cl\cdot NBrAc$, yellow plates melting at 91°; *acetylchloroamino-4-bromobenzene*, $C_6H_4Br\cdot NClAc$, rhombs melting at 108—109°; *acetylbromoamino*-2 : 4-*dichlorobenzene*, $C_6H_3Cl_2\cdot NBrAc$, yellow plates or prisms melting at 95—96°; *acetylchloroamino-4-chloro-2-bromobenzene*, $C_6H_3ClBr\cdot NClAc$, four-sided prisms melting at 74—75°; *acetylbromoamino-4-chloro-2-bromobenzene*, $C_6H_3ClBr\cdot NBrAc$, yellow rhombs melting at 85—86°; *acetylchloroamino-2-chloro-4-bromobenzene*, $C_6H_3ClBr\cdot NClAc$, rhombs or prisms melting at 88—89°; *acetylbromoamino-2-chloro-4-bromobenzene*,

$C_6H_3ClBr{\cdot}NBrAc$, yellow, four-sided prisms melting at 110—111°; *acetylchloroamino*-2 : 4-*dibromobenzene*, $C_6H_3Br_2{\cdot}NClAc$, plates or rhombs melting at 56—57°; *acetylchloroamino*-2 : 4 : 6-*tribromobenzene*, $C_6H_2Br_3{\cdot}NClAc$, prisms melting at 109—110°.

*82. "Replacement of bromine by chlorine in anilines." By F. D. Chattaway and K. J. P. Orton.

When tribromoaniline ($NH_2 : Br : Br : Br = 1 : 2 : 4 : 6$) reacts with acetylchloroamino-2 : 4-dichloroacetanilide in chloroform solution, bromine is evolved, and in addition to an azo-derivative and another coloured substance, a chlorodibromoaniline can be isolated. This aniline proves to be 4-chloro-2 : 6-dibromoaniline. With *sym*-chlorobromoanilines (2-chloro-4 : 6-dibromoaniline, 4-chloro-2 : 6-dibromoanilines, 2 : 4-dichloro-6-bromoaniline, and 2 : 6-dichloro-4-bromoaniline), it was observed that bromine was given off to a far greater extent from those anilines which possessed a bromine atom in the para-position relatively to the amino-group. Again, an aniline in which bromine had been replaced by chlorine could only be isolated in the case of those anilines where bromine originally occupied the para-position. Thus, 2 : 4-dichloro-6-bromoaniline could be obtained from 2-chloro-4 : 6-dibromoaniline, but not from 4-chloro-2 : 6-dibromoaniline.

Acetylchloroamino-2 : 4 : 6-tribromobenzene (and similar derivatives of chlorobromobenzenes) gives off bromine when heated in a sealed tube with acetic acid. No pure chlorobromoacetanilide has been isolated.

*83. "The absorption spectra of cyanogen compounds." By W. N. Hartley, F.R.S., J. J. Dobbie, D.Sc., M.A., and A. Lauder, B.Sc.

The authors described the results of an examination of the absorption spectra of cyanogen compounds, more particularly of cyanuric acid, melamine and their respective esters.

Cyanuric acid and methyl cyanurate (m. p. 135°) are commonly represented as closed chain compounds in which the chain is formed of alternate atoms of carbon and nitrogen alternately doubly and singly linked, while methyl *iso*cyanurate (m. p. 175°) is represented as a derivative of *iso*cyanuric acid containing three keto-groups and having the carbon and nitrogen atoms only singly linked. From the circumstance that pyridine, dimethylpyrazine and other similar substances, in which the carbon and nitrogen atoms are united by alternate double and single linkings, exhibit strong absorption bands, it was expected that cyanuric acid and its esters would likewise exhibit marked selective absorption. On the other hand, it was anticipated that the esters of *iso*cyanuric acid would behave like piperidine and other substances composed of a closed chain of singly linked carbon and nitrogen atoms. The authors found, however, no trace of selective absorption in any of the substances examined, and pointed out that in the absence of more satisfactory chemical evidence it is questionable whether the constitution of cyanuric acid ought to be represented by a structural formula so closely analogous to that of pyridine and of dimethylpyrazine.

The spectrographic examination confirms the view generally accepted on the evidence of chemical reactions, that cyanuric acid and methyl cyanurate (m. p. 135°) are similarly constituted and that the relations between melamine and triethylmelamine (m. p. 74°) are correctly represented by the commonly accepted formulæ.

84. "The nutrition of yeast. Part III." By A. L. Stern, D.Sc.

The author has determined the effect of varying the concentration of the sugar, the temperature of fermentation, the amount of seed-yeast, and the time, on the nutrition of yeast.

The experiments were made in exactly the same manner as those previously described (*Trans.*, 1899, 75, 202); the sugar used was dextrose, the nitrogenous nutriment, asparagine; and the inorganic nutriment, potassium phoshate, magnesium sulphate and calcium sulphate; and the yeast a pure culture from a Burton pitching yeast.

The conclusions drawn are :—

(1) Any increase of nitrogenous or inorganic nutriment beyond a definite limit will not increase either the amount of nitrogen assimilated by the yeast, or the weight of the yeast. This limit is but little greater than the largest amount which the yeast is able to assimilate under the conditions of the experiment.

(2) Any increase of the sugar is accompanied by an increase of the weight of nitrogen assimilated and of the weight of the yeast. This increase goes on up to the strongest concentrations which can be completely fermented. The rate of increase is greatest at the lowest concentrations, and falls off gradually as the concentration rises.

(3) Temperatures between 12° and 25° have but little influence on the weight of nitrogen assimilated and the weight of the yeast crop. At higher temperatures reproduction is weakened.

(4) The weight of the nitrogen assimilated and of the yeast crop is composed of two quantities: the weight of the seeding *plus* a quantity dependent on the composition of the solution.

(5) The growth of the yeast is during a portion of the fermentation

proportional to the amount of sugar fermented, and proceeds as long as any sugar remains unfermented.

From a consideration of these deductions, and of the work of others, the author concludes that there is an essential difference between the functions of the inorganic and nitrogenous nutriment on the one hand, and of the sugar on the other; that the former supply only material to the yeast, whilst the latter supplies both material and energy. Whether fermentation is caused by an enzyme or not, the author does not yet consider definitely determined, whilst there is certain amount of evidence to support this supposition, there is none to negative it.

85. "On the colloid form of piperine, with especial reference to its optical refraction and dispersion." By H. G. Madan.

The author has examined the conditions under which crystalloid piperine is converted into the colloidal allotropic form of the substance. He finds that while crystallised piperine when heated to its melting point, 135°, solidifies on cooling into a transparent resin-like substance, the latter, when thus prepared, is not permanent, but reverts spontaneously in the course of a few months into the crystalloid form. The same change takes place quickly and completely when the substance is heated to 100°. If, however, piperine is kept for an hour at a temperature of 180°, the resulting product is much more stable if not absolutely permanent as a colloid. It does not become crystalline when heated to 100° or above, nor has the lapse of 2½ years had any effect in changing it back into the crystalloid condition.

The results of a determination of the refractive indices of colloid piperine for some of the principal spectrum lines were given, from which it appears that, while its refraction is very high ($\mu_D = 1{\cdot}684$), its dispersion is quite extraordinary, the visual spectrum being nearly four times as long as that given by a prism of dense flint glass having the same refracting angle. The coefficient of dispersion ($\mu_{H\gamma} - \mu_{H\alpha}$) is 0·142, while that of carbon disulphide is only 0·057.

86. "Note on pyromucylhydroxamic acid." By R. H. Pickard and A. Neville.

The reactions of pyromucylhydroxamic acid have been studied with a view to obtaining the furan carbamides and carbamates by the method of Thiele and Pickard. These are, however, uncrystallisable oils, which decompose on hydrolysis. *Pyromucylhydroxamic acid*, $C_4H_3O{\cdot}CONHOH$, obtained by hydrolysing ethyl pyromucate with hydroxylamine, melts at 124° and forms a *benzoyl* derivative, which melts at 134°.

87. "The condensation of ethylphenylketone with benzaldehyde." By R. D. Abell, B.Sc.

Under the influence of a 20 per cent. solution of sodium ethylate, ethylphenylketone reacts with benzaldehyde to form (1) 1 : 3-diphenyl-2-methyl-trimethylene glycol, colourless needles m. p. 98—99°; (2) impure benzalpropiophenone, as a yellow oil, boiling at 210—213° (23 mm.); (3) 1 : 3-dimethyl-1 : 3-dibenzoyl-2-phenylpropane, $C_{25}H_{24}O_2$, plates, m. p. 162—163°.

If sodium methylate be similarly employed, only the first two are obtained, whilst a solution of potassium hydroxide in aqueous alcohol gives only benzalpropiophenone, which may be more satisfactorily prepared by using hydrochloric acid gas as the condensing agent.

If the first substance (the glycol) be oxidised by means of chromic acid, methyldibenzoylmethane is produced, and this, by the action of hydrazine hydrate, gives 3 : *5-diphenyl-4-methylpyrazole* which melts at 222—223°.

Benzalpropiophenone readily unites with bromine to form *benzalpropiophenone dibromide,* which is obtained as a viscid green oil by adding a solution of bromine in chloroform to one of benzalpropiophenone in the same solvent. Benzalpropiophenone with phenylhydrazine gives a *hydrazone,* $C_{22}H_{20}N_2$, yellow needles, m. p. 127—128°.

As it seemed probable that for the preparation of the third substance the previous formation of benzalpropiophenone was necessary, a mixture of equimolecular quantities of benzalpropiophenone and ethylphenylketone was treated with sodium ethylate, when a compact crystalline mass was obtained which by recrystallisation from alcohol was separated into two isomeric compounds having the formula $C_{25}H_{24}O_2$, one in the form of plates, m. p. 162—163°, identical with the 1 : 3-dimethyl-1 : 3-dibenzoyl-2-phenylpropane mentioned above, and the other as needles, m. p. 121—122°.

Sodium methylate cannot be used instead of the ethylate in this reaction.

When the isomeride, m. p. 162—163°, was heated with alcoholic ammonia, much resinous matter was formed together with a small quantity of a substance crystallising in needles, m. p. 155—156°, which from the percentage of nitrogen found may be either triphenyldimethyl dihydropyridine, $C_{25}H_{23}N$, or triphenyldimethyl pyridine, $C_{25}H_{21}N$.

This substance was also obtained by the action of hydroxylamine hydrochloride on both isomerides.

88. "A new method for the determination of hydrolytic dissociation." By R. C. Farmer, B.Sc., Ph.D.

The usual method for the determination of hydrolytic dissociation by the velocity of saponification of an ester is not applicable in certain cases, particularly those in which the acid or base under investigation is difficultly soluble in water and is precipitated during the reaction. The author has therefore devised a new method, in which the free acid or base is determined by distribution between two solvents.

An aqueous solution of the salt of a weak acid or base is shaken with a known amount of benzene or some other suitable solvent, which extracts only one of the dissociation products. From the amount extracted, the degree of hydrolysis of the salt can be calculated, the coefficient of distribution for the substance between the two solvents having been previously determined. The method was tested with a salt of hydroxyazobenzene. The values obtained at different dilutions agreed with those required by the law of dilution given by Arrhenius. The mean values found for the hydrolytic dissociation of a salt of hydroxyazobenzene at 25° were as follows:

Dilution in litres	32	50	64	80	100
Percentage hydrolysis......	0·91	1·09	1·24	1·32	1·60

Owing to the intense colour of the hydroxyazobenzene, the estimations had to be carried out gravimetrically. In most cases, volumetric methods could be used with advantage, both as regards rapidity and accuracy. Similar experiments with weak bases have not yet been attempted.

89. "The production of some new metallic borides." By S. A. Tucker, Ph.B., and H. R. Moody, B.S., M.A.

The authors describe the formation and properties of four new borides, those of zirconium, chromium, tungsten and molybdenum. These compounds were prepared by bringing an intimate mixture of the metal with boron under the influence of a temperature produced by a current of from 200 to 275 amperes and 60 to 75 volts in the electric furnace.

Combination takes place in a few minutes with the formation of compounds which are crystalline, hard, of a high specific gravity, not easily attacked by acids, and having very high melting points. The compounds thus prepared have the following formulæ Zr_3B_4, CrB, WB_2, and Mo_3B_4.

The authors were unable to produce the borides of copper and of bismuth in a like manner, and it seems therefore as if boron had no affinity for the members of the copper group, but that it combines readily with the members of the iron group.

90. "The action of lead thiocyanate on the chlorocarbonates. Part II. Carboxymethyl- and carboxyamyl-thiocarbimides and their derivatives." By R. E. Doran.

The author has already described (*Trans.*, 1896, 69, 324) the preparation and properties of carboxyethylthiocarbimide and its derivatives, and this continuation of his work deals chiefly with the thiocarbamides, thioureas, and thiocarbamates obtained from its methyl and amyl homologues. No attempt was made in this case to isolate the parent substances, but the following compounds were prepared, identified, and are described in detail.

ab-*Carboxymethylphenylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_5$, white needles, m. p. 158°; ab-*carboxymethylbenzylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}CH_2{\cdot}C_6H_5$, needles, m. p. 134°; ab-*carboxymethyl*-o-*tolylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_4{\cdot}CH_3$, needles, m. p. 172°; ab-*carboxymethyl*-p-*tolylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_4,CH_3$, short prisms, m. p. 158°; ab-*carboxymethyl-α-naphthylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_{10}H_7$, needles, m. p. 193°; ab-*carboxymethyl-β-naphthylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_{10}H_7$, minute needles, m. p. 184°; ab-*carboxymethylmethylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}CH_3$, needles, m. p. 146°; ab-*carboxymethylethylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_2H_5$, needles, m. p. 86°; ab-*carboxymethyl*iso*butylthiocarbamide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_4H_9$, long prisms, m. p. 83°; *carboxymethylthiourea*, $CH_3O{\cdot}CO{\cdot}N{:}C(NH_2)SH$, short prisms, m. p. 166°; *carboxymethylpiperidylthiourea*, $CH_3O{\cdot}CO{\cdot}N{:}C(SH){\cdot}N{:}C_5H_{10}$, needles, m. p. 97°; *carboxymethylphenylsemithiocarbazide*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}C(SH){:}N{\cdot}NH{\cdot}C_6H_5$, glistening plates, m. p. 180°; *methyl carboxymethylthiocarbamate*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}OCH_3$, feathery needles, m. p. 46°; *ethyl carboxymethylthiocarbamate*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}OC_2H_5$, needles, m. p. 83°; *benzyl carboxymethylthiocarbamate*, $CH_3O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}OCH_2{\cdot}C_6H_5$, cream-white needles, m. p. 103°.

Derivatives of carboxyamylthiocarbamide:

ab-*Carboxyamylphenylthiocarbamide*, $C_5H_{11}O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_5$, white needles, m. p. 97—98°; ab-*carboxyamyl*-o-*tolylthiocarbamide*, $C_5H_{11}O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C_6H_4,CH_3$, white needles, m. p. 96—97°.

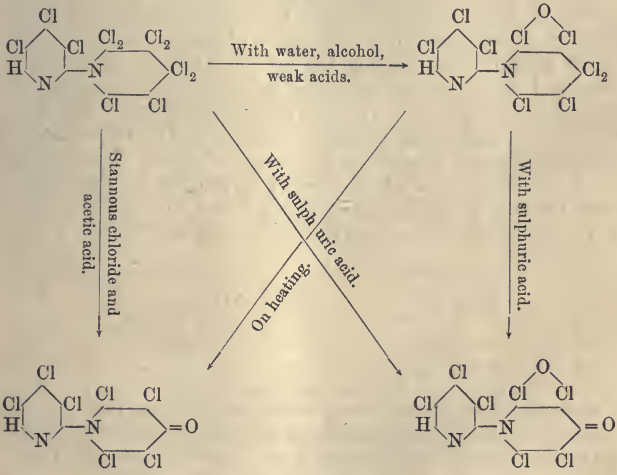
Carboxyamylthiourea was also obtained, but in too small a quantity to permit of its satisfactory identification.

91. "The chlorine derivatives of pyridine. Part VII. Some condensation products." By W. J. Sell, M.A., F.R.S., and F. W. Dootson, M.A.

A series of experiments having for their object the determination of the orientation of a compound, $C_{10}HCl_{11}N_2$, which has been obtained by the action of chlorine on pyridine hydrochloride, together with certain of its derivatives (*Trans.*, 1899, 75, 980) was described.

This substance, which is the principal product of the chlorination, may be crystallised unaltered from chloroform or acetone, but if the solvent contains the hydroxyl group the compound is decomposed. With benzoic and other acids it reacts, giving a theoretical yield of the acid chloride in accordance with the equation $C_{10}HCl_{11}N_2 + C_6H_5CO_2H = C_6H_5COCl + C_{10}HCl_9N_2O + HCl$.

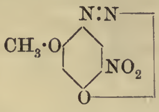
The following formulæ exhibit the relationship between the parent compound and certain of its derivatives :



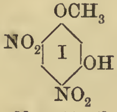
92. "The diazotisation of dinitroanisidine and the constitution of the resulting product." By R. Meldola, F.R.S., and J. V. Eyre.

A paper just published by Freyss (*Bull. Soc. Ind. de Mulhouse*, 1901, 70, 375) anticipates some conclusions at which the authors have arrived as the outcome of an investigation upon which they have been engaged since last October. They are led, therefore, to place upon record the results of those experiments which appear to give independent support to the conclusions of the author above named. This work is an extension of that already published (Meldola and Wechsler, *Trans.*, 1900, **77**, 1172; *Proc.*, 1898, **14**, 226).

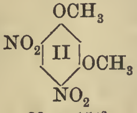
The crystalline diazo-compound, obtained by the action of a nitrite on dinitroanisidine in acetic acid solution, is a diazoxide of the formula:



The proof of this constitution is given by several considerations, some of which appear from the experiments of Freyss, the most cogent, perhaps, being its ready convertibility into nitromethylresorcinol, $C_6H_3{\cdot}NO_2{\cdot}OH{\cdot}OCH_3 = 1:2:4$. The authors find the most convenient method for bringing about this conversion is to dissolve the diazoxide in alcoholic sodium hydroxide. The decomposition takes place at the ordinary temperature, with the evolution of nitrogen and the formation of aldehyde. On diluting the alkaline alcoholic solution with water and acidifying, the nitroresorcinol methyl ether separates in a crystalline form, and is best purified by steam distillation. The nitroresorcinol ether gives the dimethyl ether of m. p. 72—73° on methylation with dimethyl sulphate in the presence of alkali. The mono- and the di-methyl ethers are both nitrated by solution in cold, fuming nitric acid, the dimethyl ether dissolving at first with a green colour. The corresponding dinitro-derivatives have the constitutions:



M. p. 110·5°.

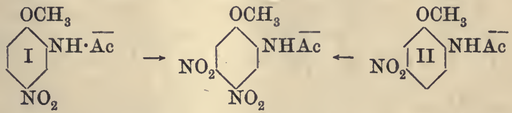


M. p. 154°.

The first of these crystallises from alcohol in large, yellow plates. The second crystallises in small, white needles from alcohol, and in very minute needles from boiling water; it is obtained also (mixed with colouring matters) by the direct nitration of resorcinol dimethyl ether in acetic acid with excess of fuming nitric acid, and its constitution as a derivative of resorcinol is thus confirmed. The nitroresorcinol monomethyl ether benzoylates very readily by the Schotten-Baumann method. The benzoyl derivative, $C_6H_3{\cdot}NO_2{\cdot}OC_7H_5O{\cdot}OCH_3 = 1:2:4$, crystallises from alcohol in flat, white needles melting at 95°. The nitro-derivative, when dissolved in acetic acid, gives an intense blue colour on the addition of zinc dust. If reduced with zinc dust and acetic acid in the presence of acetic anhydride, the acetamino-derivative, $C_6H_3{\cdot}NHAc{\cdot}OH{\cdot}OCH_3 = 1:2:4$, is obtained. This crystallises from water in lustrous, flat, white needles, which become brown on exposure to the air. The melting point is 164—165°.

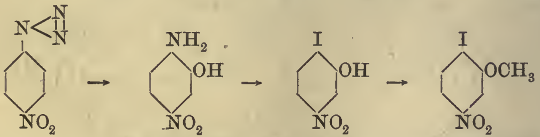
The diazoxide is remarkably stable towards acids; it can be boiled with dilute hydrochloric or sulphuric acid and can be crystallised from boiling glacial acetic acid or from acetic anhydride without undergoing decomposition. It is decomposed on boiling with hydriodic acid solution and the product is iodonitroresorcinol methyl ether (Meldola and Wechsler, *loc. cit.*, 1173), $C_6H_2{\cdot}OCH_3{\cdot}OH{\cdot}NO_2{\cdot}I = 1:3:4:6$. The azo-$\beta$-naphthol derivative described in the former note (*loc. cit.*) has the formula $C_6H_4{\cdot}NO_2{\cdot}OCH_3{\cdot}OH{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH$. In addition to the properties already assigned to this compound, it may be added that it is distinctly phenolic in character, dissolving in cold aqueous alkali with a dull claret-red colour and being precipitated unchanged by acids. The phenolic character is due to the hydroxyl group in the para-position. An examination of the product of the action of ammonium sulphide on the azo-compound has shown that no amino-azo-compound is formed, and this is in accordance with the view that the nitro-group is not in the para-position with respect to the azo-group (Meldola, *Trans.*, 1883, **43**, 425).

The constitution of dinitroanisidine (m. p. 188°) first described (Meldola and Wechsler, *loc. cit.*) follows from the fact that it is obtainable by the further nitration of *both* the nitroacetanisidides resulting from the nitration of *o*-acetanisidide:



The authors have proved this directly by the nitration of carefully purified specimens of the mononitroacetyl derivatives. No. I was prepared by the reduction of dinitroanisole and acetylation of the nitroanisidine (Meldola, Woolcott, and Wray, *Trans.*, 1896, **69**, 1330). No. II was prepared from the corresponding nitroanisidine, the latter being obtained pure, by a modification of the method formerly described (*Proc.*, 1898, **14**, 226). The mixture of nitroacetyl derivatives resulting from the nitration of *o*-acetanisidide is boiled with dilute alkali till completely hydrolysed. The mixed nitroanisidines on being dissolved in hot dilute sulphuric acid deposit, on cooling, silvery scales of the sulphate of the *p*-nitro-compound, $C_6H_3{\cdot}NO_2{\cdot}NH_2{\cdot}OCH_3 = 1:4:5$, the sulphate of the isomeric compound remaining in solution. The crystalline sulphate gives pure *p*-nitro-*o*-anisidine on treatment with dilute alkali and crystallisation of the product from hot water. In order to characterise further the two nitroanisidines and the dinitroanisidine, the benzoyl derivatives have been prepared: $C_6H_3{\cdot}NO_2{\cdot}NH(C_7H_5O){\cdot}OCH_3 = 1:4:5$, white silky needles from alcohol, m. p. 149—150°; $C_6H_3{\cdot}NO_2{\cdot}NH(C_7H_5O){\cdot}OCH_3 = 1:3:4$, slender ochreous neeedles from alcohol, m. p. 160—161°; $C_6H_2{\cdot}(NO_2)_2{\cdot}NH(C_7H_5O){\cdot}OCH_3 = 1:2:5:4$, ochreous scales from acetic acid, m. p. 185—186°.

The constitution of the *p*-nitro-*o*-anisidine was proved by two methods differing from those adopted by Freyss, as well as by conversion into the *p*-nitro-guaiacol of m. p. 104°. The latter compound, of which the discovery is assigned to Rupe (*Ber.*, 1897, **30**, 2446), was first described by one of the authors (Meldola, *Proc.*, 1896, **12**, p. 125). The *p*-nitro-*o*-anisidine when diazotised and the amino-group replaced by iodine in the usual way, gave an iodonitroanisole which crystallised in straw-coloured needles melting at 127°—128°. The constitution of this compound might have been expected to correspond with that of the nitro-aminophenol, m. p. 201°—202°, obtained by Friedländer and Zeitlin (*Ber.*, 1894, **27**, 196) by heating *p*-nitrobenzenediazimide with sulphuric acid. Some of the nitroaminophenol was prepared by this method and converted into the corresponding iodonitrophenol which crystallises from alcohol in ochreous needles melting at 146°—147°. The silver salt of the latter, which is a brick-red amorphous powder, on treatment with methyl iodide, gave the same iodonitroanisole m. p. 127°—128°, as that obtained from *p*-nitro-*o*-anisidine:

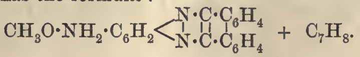


M. p. 201—202°. M. p. 146—147°. M. p. 127—128°.

The other method consisted in combining the diazotised nitroanisidine with *β*-naphthol in the usual way and reducing the nitroazo-compound to an aminoazo-compound by ammonium sulphide. The nitroazo-compound is obtained as a scarlet precipitate on mixing solutions of the diazonium salt and *β*-naphthol dissolved in sodium hydroxide. It crystallises from glacial acetic acid, in which it dissolves with difficulty, in filamentous needles of a dull red colour with a slight metallic reflex. Its melting point is 269°. It dissolves in alcoholic soda with a violet colour and with a similar colour in strong sulphuric acid, the latter solution becoming redder on dilution with water. The solution in alcoholic soda becomes red on heating with ammonium sulphide and on dilution with water the aminoazo-compound, $NH_2{\cdot}C_6H_3{\cdot}OCH_3{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH$, separates out in bronzy scales. The melting point of this compound is above 300°. It dissolves in alcohol with a bordeaux-red colour which becomes orange on adding hydrochloric acid. It dissolves in hot aqueous hydrochloric acid with a dull red and in strong sulphuric acid with a magenta-red colour, becoming more orange on dilution. The reducibility of the nitro-group without the separation of the nitrogen atoms of the azo-group may be taken as proof that the two groups are in the para-position with respect to one another.

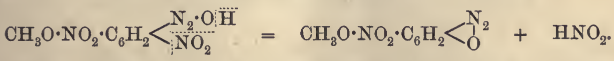
The constitution of the nitroanisidine of Cahours (Meldola, Woolcott, and Wray, *loc. cit.*) was further proved by converting it into the corresponding iodonitroanisole by replacing the amino-group by iodine by the diazo-method. The iodonitroanisole, $C_6H_3\cdot NO_2\cdot I\cdot OCH_3 = 1:3:4$, melts at 95—96° and is identical with that described by Reverdin (*Ber.*, 1896, **29**, 998).

Experiments were in progress to obtain direct evidence of the constitution of the dinitroanisidine at the time of appearance of the paper by Freyss. The triaminoanisole obtained by reducing the dinitroanisidine with tin and hydrochloric acid forms a crystalline hydrochloride, but it is very unstable, passing readily into a deep violet colouring matter on exposure to the air. The dinitroacetanisidide does not give an anhydro-base on reduction, an observation which is in harmony with the view that the acetamino-group is not in the ortho-position with respect to a nitro-group. On the other hand, that the triaminoanisole contains two amino-groups in the ortho-position is proved by the formation of an azine with phenanthrenequinone. On heating together equimolecular weights of the triamine and the quinone in glacial acetic acid, the aminoazine is gradually formed, and on adding hydrochloric acid the hydrochloride is completely thrown out on cooling as a dull red precipitate. The free base is an ochreous powder which dissolves in alcohol with a magnificent green fluorescence. It does not readily crystallise, but separates from boiling toluene in the form of brown nodules having a melting point of about 237°, but softening before this temperature. The base thus obtained contains one molecule of toluene and has the formulæ:



$$\mathrm{CH_3O\cdot NH_2\cdot C_6H_2}\Big<\begin{matrix}\mathrm{N\cdot C\cdot C_6H_4}\\ | \quad \| \quad | \\ \mathrm{N\cdot C\cdot C_6H_4}\end{matrix} + \mathrm{C_7H_8}.$$

The result of this investigation thus confirms the conclusion that on diazotising 3 : 4-dinitro-*o*-anisidine in acetic acid, it is the 4-nitro-group which is eliminated, probably in accordance with the scheme:



$$\mathrm{CH_3O\cdot NO_2\cdot C_6H_2}\Big<\begin{matrix}\mathrm{N_2\cdot O} \vdots \mathrm{H}\\ \vdots\mathrm{NO_2}\end{matrix} = \mathrm{CH_3O\cdot NO_2\cdot C_6H_2}\Big<\begin{matrix}\mathrm{N_2}\\ | \\ \mathrm{O}\end{matrix} + \mathrm{HNO_2}.$$

The more exact nature of the mechanism of the change will be made the subject of further investigation.

ADDITIONS TO THE LIBRARY.

I. Donations.

Cohen, J. B. Practical organic chemistry for advanced students. London 1900. From the Author.

II. By Purchase.

Ahrens, F. B. Anleitung zur chemisch-technischen Analyse. Ill. Stuttgart 1901.

Meyer, O. E. The kinetic theory of gases: elementary treatise, with mathematical appendices. Translated from the second revised edition by R. E. Baynes. London 1899.

Bredig, Georg. Anorganische Fermente. Ill. Leipzig 1901.

Klöcker, A. Die Gärungsorganismen in der Theorie und Praxis der Alkoholgärungsgewerbe. Ill. Stuttgart 1900.

Migula, W. Compendium der bakteriologischen Wasseruntersuchung nebst vollständiger Uebersicht der Trinkwasserbakterien. Ill. Wiesbaden 1901.

Nietzki, Rudolf. Chemie der organischen Farbstoffe. Fourth edition. Berlin 1901.

Wedekind, Edgar. Die heterocyklischen Verbindungen der organischen Chemie. Leipzig 1901.

Pamphlets.

Wendt, Gustav. Ueber einige unvollkommenheiten des Substanzgesetzes und ihre Abstellung. Berlin 1900.

Wislicenus, Johannes. Sir Edward Frankland. Leipzig 1901. From the Author.

At the next meeting, on Thursday, June 6th, the following papers will be communicated:—

"A laboratory method for the preparation of ethylene." By G. S. Newth.

"Oroxylin." By W. A. H. Naylor and C. S. Dyer.

"Some relations between physical constants and constitution in benzenoid amines. II." By P. Gordon and L. Limpach.

"The constitution of the acids obtained from α-dibromocamphor." By A. Lapworth and W. H. Lenton.

"The decomposition of chlorates. IV. The supposed mechanical facilitation of the decomposition of potassium chlorate." By W. H. Sodeau.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 10th.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Thursday, June 20th, 1901.

Adams, Ormsby Gore,
Stawell, Victoria, Australia.

Lecturer on Chemistry and Mineralogy, &c. Studied Chemistry, &c., at Otago University (New Zealand University) for three years, 1896—1898. Was Assayer and Analyst at Tasmanian Smelting Company's Works at Zeehan, Tasmania, 1900. At present, Lecturer on Chemistry, Mineralogy, &c., at Stawell School of Mines, Victoria, Australia. Holds Diploma of Associate of Otago University School of Mines, and also Certificate of Metallurgical Chemist and Assayer from the same institution.

Orme Masson. Fred. W. Steel.
D. Avery. *C. R. Blackett.*
A. W. Craig.

Ashwell, Guy,
Standard Bank, Bulawayo.

Analytical Chemist and Assayer.

Charles M. Stuart. Thomas Purdie.
Frank Clowes. *J. Emerson Reynolds.*
Edward T. Shelbourn.

Aspinall, Thomas,
42, Gilnow Road, Bolton.

Analytical Chemist. Research in Sewage Purification and general interest in Chemistry.

Walter Ratcliffe, William B. Mason.
Jno. L. Whiteside. *Frank Scudders.*
J. Carter Bell. *George J. Allen.*

Aston, William George,
4, Dalkeith Road, Ilford.

Chemist in the Laboratory of the Gas Light and Coke Company's Tar Product Works, Beckton. Scholar for three years at People's Palace Day Schools. Scholar for two years at the East London Technical College (People's Palace) Day Classes. Passes in Honours at the South Kensington Examinations in Organic Chemistry, Theoretical and Practical, and Inorganic, Practical. Joint Author with Dr. Hewitt of papers, "Bromination of Benzeneazophenol" (*Trans.*, 1900, 77, 712) ; "Bromination of Benzeneazophenol," Part II (*Trans.*, 1900, 77, 810).

J. T. Hewitt.
Frank Dixon.
T. Wilton.
Edgar S. Barralet.
William A. Rugginz.
Samuel Clift.

Barker, Hubert Haigh,
3, Waverley Place, St. John's Wood, N.W.

Analytical Chemist. Articled pupil to Professor Bayne for three years in Analytical Chemistry; at present, junior Assistant and Demonstrator at the Royal Veterinary College.

James Bayne.
Hubert E. Lindley.
W. B. Bottomley.
Percy A. E. Richards.
Bernard Dyer.

Beaven, Edwin Sloper,
5, Boreham Terrace, Warminster.

Maltster and Chemist. Interested in the Chemistry of Agriculture and Malting. Author, with J. M. H. Munro, D.Sc., of papers in *J. R. Agricultural Society*, on "Manurial Conditions Affecting the Quality of Malting Barley," March, 1897, and June, 1900.

J. Henry Gilbert.
Samuel Rideal.
John M. H. Munro.
N. Story Maskelyne.
E. R. Moritz.
Horace T. Brown.

Bedford, Fred,
9, Market Place, Sleaford, Lincs.

Teacher of Chemistry. Three years' practical experience in the Analysis of Water and Food-stuffs, and in Organic Chemistry generally. Second Class Honours in Chemistry at London Inter. B.Sc. Advanced Stage Certificates Science and Art Department, Inorganic and

Organic Chemistry. Lecturer in Chemistry under Kesteven County Council. Desirous of increasing my knowledge of Chemistry.

Reginald B. Brown.
Hudson Donaldson.
Alex. W. Bain.
J. H. Allworthy.
J. T. Hewitt.
Chapman Jones.
James C. Philip.
John McCrae.

Bridges, Joseph Samuel,

45, Thistlewaite Road, Clapton, N.E.

Principal, Walthamstow Science and Technical Institute, Senior Professor of Biology, City of London College. B.Sc. Lond.; Honours in Chemistry. Lecturer and Demonstrator in London laboratories for 17½ years. Research in Physiological Chemistry at King's College.

Isaac Sydney Scarf.
Chapman Jones.
E. J. Jackman.
Harold W. Harrie.
J. C. Mascarenhas.

Crabtree, Arthur,

9, Bigg Market, Newcastle-on-Tyne.

Science Lecturer in Physiology, Hygiene and Chemistry. Science Lecturer in Newcastle Day and Evening Schools. Student of Chemistry, Elem., Adv., and Honours, for six years under Drs. C. Gerland, R. H. Pickard, and G. Smith, and obtained many certificates. For a few years Teacher of Physiology and Hygiene under the Science and Art Depart. The Society's publications would be most useful to me in my further studies and labours.

Robert H. Pickard.
T. W. Lockwood.
R. S. Cahill.
Wm. Lewins.
C. Gerland.
James Foulds.

Dean, George,

2, Scriven Grove, Knaresborough.

Senior Science Master, King James's Grammar School, Knaresborough. M.A. Cambridge University. First Class, Part I, Natural Sciences Tripos, 1896; First Class, Part II, Natural Sciences Tripos, 1897 (with Chemistry as special subject). Author of "Equivalent Weight of Cyanogen" (*Proc. Chem. Soc.*, 1898, p. 174). Author of "The Atomic Weight of Nitrogen" (*Trans.*, 1900, p. 117).

G. D. Liveing.
W. J. Sell.
H. J. H. Fenton.
James Dewar.
Alexander Scott.

Eling, Thomas Henry James, B.A.,

32, Hill Top Avenue, Shepherd's Lane, Leeds.

Chemistry Instructor, Southern Higher Grade School, Leeds. Graduate of Oxford University, with Honours in Chemistry.

V. H. Veley. J. E. Marsh.
W. W. Fisher. J. Hembrough.
John Watts.

Hanson, Edward Kenneth,

Hadley Wood, N.

Student of Natural Science. First Class Natural Science Tripos, Part I, 1900. Desires admission in order to enjoy the advantages of membership, use of library, &c.

M. M. Pattison Muir. H. J. H. Fenton.
S. Ruhemann. W. T. N. Spivey.
R. S. Morrell.

Harry, Frederick Thomas,

106, Sandmere Road, Clapham, S.W.

Chemical Student. A three years' Chemical course at Finsbury Technical College, obtained Certificate, and am now engaged in Research at the Central Technical College.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. T. M. Lowry.
Edwin C. Jee.

Horton, Edward,

8, Orford Street, Chelsea, S.W.,

Chemical Student. I studied Chemistry for 3 years at Finsbury Technical College, obtaining the College certificate in 1900. Since October, 1900, I have been engaged in research work under Dr. Armstrong at the Central Technical College.

Henry E. Armstrong. Edward W. Lewis.
Gerald T. Moody. James Moir.
William A. Davis. Sidney S. Napper.

Kiddell, Christopher George,

24, Queen's Gardens, Muswell Hill, N.

Science Master and Lecturer under Herts County Council. B.A.

W. B. Hards. J. W. Shepherd.
Henry E. Armstrong. *G. T. Morgan.*
M. O. Forster. *James C. Philip.*

Lattey, Robert Tabor,

Trinity College, Oxford,

Student of Chemistry.

H. Brereton Baker. Allan F. Walden.
D. H. Nagel. Harold Hartley.
F. R. L. Wilson.

Lehmann, Adolf Ludwig Ferdinand,

Bangalore, Mysore, India.

Agricultural Chemist to Gov. Mysore. Graduate University of Toronto (B.Sc.), 1889. Assistant Chemist Central Experimental Farm, Ottawa, Canada, 1890—1893; Chemist La. Exp. Station, New Orleans, La., U.S.A., 1893—1894; Student Wislicenus, Leipzig, Germany (Ph.D.), 1894—1897. Dissertation "Dibenzoyldiphenylbutadiën and its Reduction to Tetraphenylbenzoyl" (*Annalen*, 302, p. 195). Lecturer on Organic Chemistry, Queen's University, Kingston, Canada, 1897—1899.

J. Walter Leather. W. H. Ellis.
Frank T. Shutt. *W. R. Lang.*
Frank G. Wait. *W. Lash Miller.*

Lowson, William,

83, Kyrle Road, Clapham Common, London.

Assistant Analyst in Government Lab. Six years' experience in Pharmacy and registered as Chemist under Pharmacy Act; three years' training at Yorkshire College, Leeds; B.Sc. (Lond.), A.I.C. Demonstrator in Chemistry at Yorks College.

T. E. Thorpe. John McCrae.
Arthur Smithells. Julius B. Cohen.
H. M. Dawson.

Macdonald, F. G.,

Government Laboratory, Durban.

Analytical Chemist and Assayer. Four years assistant chemist Roxburgh Sugar Refining Co., Greenock. Three years with Messrs. Tatlock and Readman, City Analysts, Glasgow, part of which time as a student and the remainder as an assistant. Two years Assayer to Durban Roodepoort Gold Mining Co., Transvaal, three years Cyanide Manager to the same company. At present in the Government Laboratory, Durban, as temporary assistant, as my services are still retained by the Durban Roodepoort G. M. Co.

E. Nevill. R. R. Tatlock.
Angus Smith. R. T. Thomson.
John Clark.

McLaren, Daniel, B.Sc.,

Brookdale, Grey Street, Stalybridge.

Science Teacher. Graduate in Science (Chemistry and Physics). St. Ands. "Forrester Prizeman" (Chemistry). 2nd "Neil Arnott" Prizeman (Physics). Teacher of Chemistry since 1890. Principal and teacher of Chemistry, Technical School, Stalybridge.

Thomas Purdie.
Joseph Brierley.
Albert Morris.
Jas. Grant.
John Allan.

Oram, Frank,

Market Place, Romsey.

Pharmaceutical Chemist. Senior Medallist in Chemistry and Materia Medica.

W. B. Randall.
J. Brierley.
Harry Wilson.
David Howard.
Peter MacEwan.
Thomas Tyrer.

Powell, John,

Balliol House, Wentworth Street, E.

Teacher of Physics at the Goldsmiths' Institute, New Cross. Am a B.Sc., London.

William J. Pope.
Stanley J. Peachey.
A. W. Harvey.
M. O. Forster.
Henry. A. Miers.

Purvis, John Edward,

University Chemical Laboratory, Cambridge.

Assistant to the Professor of Chemistry, Cambridge University. M.A. (St. John's College, Cambridge); Associate Royal College of Science (Ireland); Associate Institute of Chemistry.

G. D. Liveing.
James Dewar.
Alexander Scott.
H. J. H. Fenton.
W. J. Sell.

Russell, James Bertram,

356, Padiham Road, Burnley,

Schoolmaster. B.Sc. (Lond.). Late Scholar and Associate of University College, Cardiff. Formerly Lecturer in Chemistry for the County Council of Hertfordshire. Author of "Notes on Volumetric Analysis." For 5 years Senior Science Master, Grammar School, Burnley.

Claude M. Thompson.
E. P. Perman.
G. S. Turpin.
H. B. Dixon.
W. H. Perkin, jun.

Sandford, Thomas,

2, Market Place, Ulverston.

Analytical Chemist. Analytical Chemist to Messrs. Harrison, Ainslie and Co., Ltd., Ulverston, Charcoal iron makers and mines owners. Student under E. Richards, Esq., F.I.C., and F. B. Last, Esq., F.C.S.

Frank B. Last. Geo. R. Thompson.
Gilbert Howard Daniel. *Richd. Spencer.*
James E. Ferguson.

Sheppard, Samuel Edward,

Ravensmere, Bromley Road, Catford, S.E.

Student in the Chemical Department of University College, London. Passed Intermediate Examination in Science (Honours). Reading for B.Sc. (Honours) Examination at the London University.

William Ramsay. Edward C. Cyril Baly.
Morris W. Travers. Lionel M. Jones.
Charles M. Stuart.

Sichel, Gerald Theodore Sylvester,

R.N. Hospital, Haslar, Gosport.

Surgeon R.N. Assistant Instructor, &c., to Surgeons on entry into R.N. Lecturing and demonstrating in practical analytical work and on serum therapeutics since Feb. 1900. Admiralty analyses of water supplies of the service, foods, liquors, and general hygienic laboratory work since Feb. 1900. F.R.C.S. (Eng.); L.R.C.P. (Lond.); late H. S. Guy's Hospital.

Thos. Stevenson. Walter C. C. Pakes.
John Wade. William J. Pope.
Chas. Mills.

Smith, Andrew Biggam,

Queenstown, Cape Colony, S.A.

Analytical Chemist. Student of Chemistry in Andersonian College, Glasgow, under Prof. Henderson, D.Sc., from March 1892 to April 1895. For some time Chemist with the Scottish Oil and Chemical Co., Keppochhill, Glasgow, now with M. Armstrong, Chemist and Druggist, Queenstown, Cape Colony, South Africa.

G. G. Henderson. Thomas Gray.
James Robson. Matthew A. Parker.
A. Humboldt Sexton.

Spence, John Davidson,

2, Hawk Hill Place, Perth Road, Dundee.

Assistant Chemist and Assayer in the Muntz Metal Works, Birmingham. I was an assistant Chemist in the laboratory of Mr. G. D. Macdougald, F.I.C., Public Analyst of Dundee, for three years, and I am engaged in research work for the firm with whom I am at present engaged.

John S. Lumsden. James Walker.
John Foggie. *Jas. Braik Mason.*
Percy F. Frankland.

Tankard, Arnold Rowsby,

67, Surrey Street, Sheffield.

Analytical Chemist. Analytical and Literary Assistant to Mr. A. H. Allen. Undertaker of various investigations recorded in *Commercial Organic Analysis*, *Chemical News*, &c.

Alfred H. Allen. G. E. Scott-Smith.
P. J. Hartog. *J. F. Thorpe.*
George Young. *D. L. Chapman.*
Wm. A. Bone.

Tatam, George William Gerald,

Mercers' Hall, Cheapside, E.C.

Chemist in charge of the Laboratory and Gas Testing Department of the Gas Light and Coke Company's Nine Elms Station. I am a past student of the City and Guilds of London Institute, Finsbury, where I obtained the Diploma in the Department of Applied Chemistry.

Raphael Meldola. Ernest H. Roberts.
F. Southerden. Otto Hehner.
Greville Williams.

Whitton, William Arthur,

Bristol Brewery, Brighton.

Brewer. Two years pupil to H. E. Wright, Esq., F.C.S. Nine months pupil to Messrs. Matthews and Lott, Analytical Chemists. Two and a half years 2nd Brewer, Cheltenham Original Brewery Co. Ltd., now Brewer, Bristol Brewery, Brighton. Desirous of keeping myself informed in Chemical Science.

Herbert Edward Wright. Arthur A. Leon.
Chas. Geo. Matthews. *Jas. O'Sullivan.*
William Frew.

Whittle, James,

30, Bridge Street, Morpeth.

Chemist. Interested in Agricultural and Photographic Chemistry and desirous to obtain the Society's papers, &c.

William Mair.
R. E. S. Richardson.
Frank R. Dudderidge.
Geo. F. Merson.
Fredk. Gilderdale.
John Gibson.

Wilson, Duncan Randolph, B.A.,

Magdalen College, Oxford.

Lecturer in Natural Science at Magdalen College, Oxford. First Class in the Final School of Natural Science (Chemistry) at Oxford, 1898. *Publication.* Luther und Wilson, "Ueber das elektromotorisches Verhalten von Stoffen mit mehreren Oxidationsstufen" (*Zeitschr. f. physik. Chemie*, 1900, 488).

Henry A Miers.
V. H. Veley.
J. E. Marsh.
John Watts.
W. W. Fisher.
H. L. Bowman.
D. H. Nagel.
A. Vernon Harcourt.

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Issued 15/6/1901

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 239.

June 6th, 1901. Professor THORPE, C.B., F.R.S., Vice-President, in the Chair.

Messrs. Oldershaw, Martin, Jemmett, Dunstan, Bousfield, Taylor, Goltz, and Hyder were formally admitted Fellows of the Society.

The following Certificates were read for the first time:—Samuel Irwin Crookes, Thanet Street, Clay Cross, Chesterfield; Herbert Blackmore Hammond, 3 Vicar's Close, Lichfield; Christian Müller, 10 Selwyn Avenue, Richmond, S.W.; Rowland Samuel Potter, 2 Museum Hill, Haslemere; Robert Stephenson, jun., Burwell, Cambridgeshire; Frank Wade, 36 Craven Park, Harlesden, N.W.; Morton Wager, 5 Wilton Street, Batley.

Of the following papers, those marked * were read.

*93. "A laboratory method for the preparation of ethylene." By G. S. Newth.

By substituting tribasic phosphoric acid for sulphuric acid in the ordinary process for obtaining ethylene, this gas may be prepared in a high state of purity. Syrupy phosphoric acid is boiled in a flask until the temperature reaches 200°, when ethyl alcohol is delivered drop by drop to the bottom of the boiling liquid. If the temperature is maintained about 220°, an abundant evolution of the gas takes place. As the liquid does not char or froth up, the operation may be conducted in a small reaction vessel; and as the gas is entirely free from carbon dioxide, and of course from sulphur dioxide, it is not necessary to wash it.

The liquid products of the reaction, consisting of water, ether, unchanged alcohol, and a small quantity of an oily liquid, are collected in a vessel cooled by ice, the ethylene passing on practically pure.

By acting in a similar manner upon methyl alcohol, the gas evolved is pure methyl ether; from propyl alcohol, propylene is produced. In the case of the normal alcohol, a temperature about 250° is required to bring about the decomposition, whilst the secondary alcohol splits up rapidly at 210°.

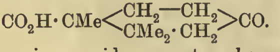
*94. "Oroxylin." By W. A. H. Naylor and C. S. Dyer.

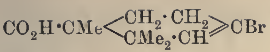
The authors described the methods of isolation and purification of oroxylin, a yellow, crystalline substance obtained from *Oroxylum Indicum.*

Its chief decomposition product, through the action of caustic alkali of different strengths, is benzoic acid, but if the reagent be applied in the cold and in the form of a weak solution, the primary product is benzaldehyde. With bromine it forms a dibromo-derivative which crystallises in needles melting at 175°; on acetylation, a triacetyl derivative is obtained which crystallises in colourless needles melting at 150°. The authors conclude that oroxylin contains three hydroxyl groups, a loosely attached benzene nucleus, and they assign to it the formula $C_{19}H_{14}O_6$.

*95. "The constitution of the acids obtained from α-dibromocamphor." By A. Lapworth and W. H. Lenton.

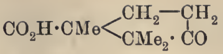
When tribromocamphonolactone (*Trans.*, 1900, 77, 458) is hydrolysed with alkali, and the product oxidised with cold sodium hypobromite, a mixture of acids is obtained from which trimethylsuccinic acid and a small quantity of camphoronic acid have been isolated. The greater portion of the mixture, however, consists of a dibasic lactonic acid, $C_9H_{12}O_6$, which has been identified with the acid hitherto known as β-hydroxycamphoronic acid.

The authors conclude that when bromocamphorenic acid is converted into α-monobromocampholid, the lactonic oxygen becomes attached to the ring at the δ-position with regard to the carboxyl group, instead of at the γ-position as was at first thought probable (*Trans.*, 1899, 75, 1139), the only possible formula for camphonic acid being  $CO_2H\cdot CMe{<}\begin{matrix}CH_2\text{—}CH_2\\ CMe_2\cdot CH_2\end{matrix}{>}CO$. Bromocamphorenic acid and camphonic acid must be represented by the formulæ



$CO_2H\cdot CMe\left\langle\begin{matrix}CH_2\cdot CH_2\\ CMe_2\cdot CH\end{matrix}\right\rangle CBr$

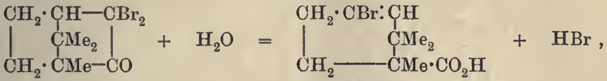
and



$CO_2H\cdot CMe\left\langle\begin{matrix}CH_2-CH_2\\ CMe_2\cdot CO\end{matrix}\right.$

respectively.

The formulæ thus arrived at are in complete accordance with the properties of the compounds, and it is now easy to understand the great difference in the reactivities of the carbonyl groups of camphonic acid and camphononic acid. The change induced in α-dibromocamphor by moist silver compounds must be represented by the scheme



and the authors suggest that an intermediate compound containing a trimethylene ring may be formed. Such an assumption is possibly applicable to many other changes in the camphor and terpene series, including the apparent migrations of methyl groups from one carbon atom to an adjacent one (a type of change otherwise without real analogy) and the formation of camphene derivatives from bornyl chloride and allied compounds (compare Marsh, *Proc.*, 1899, **15**, 54).

*96. "The decomposition of chlorates. IV. The supposed 'mechanical' facilitation of the decomposition of potassium chlorate." By W. H. Sodeau, B.Sc.

The supposed analogy between the decomposition of potassium chlorate and the boiling of water, in respect of the facilitating action of certain powders, is invalidated by the fact of the former not being appreciably facilitated by reduction of pressure to 1 mm. (*Trans.*, 1900, **77**, 144). There would seem to be a possibility of chemical action with all substances known to produce a marked effect on the rate of decomposition of potassium chlorate.

From an experiment in which 1 per cent. of barium sulphate was added and a 500 per cent. increase of rate observed, Veley concludes that "chemically inert" powders facilitate the decomposition (*Phil. Trans.*, 1888, **179**, [A], 270).

The author has studied the effect of adding 1 per cent. of barium sulphate, and finds that the average increase of rate amounts to only 16 per cent. There is evidence of the formation of a little barium chlorate by double decomposition, and this would appear to account for the slight facilitation observed.

It is concluded that the supposed ability of chemically inert solid particles to facilitate the decomposition of potassium chlorate is unsupported by experimental evidence, and, if actually existent, is inadequate to explain even a small fraction of the effect of the oxides of manganese, iron, cobalt, nickel, and copper. The action of these latter substances would, therefore, appear to be entirely chemical.

*97. "On the action of sodium methoxide and its homologues on benzophenone chloride and benzal chloride." By J. E. Mackenzie, D.Sc., Ph.D.

The author has already (*Trans.*, 1896, **69**, 985) described the preparation of dimethoxy-, diethoxy-, and dibenzoxy-diphenylmethanes by the action of sodium meth-, eth-, and benz-oxide respectively on benzophenone chloride. To these are now added, *dipropoxydiphenylmethane*, $(C_6H_5)_2C(OCH_2{\cdot}CH_2{\cdot}CH_3)_2$, colourless, prismatic crystals, m. p. 33—34·5°; *diisobutoxydiphenylmethane*, $(C_6H_5)_2C[OCH_2{\cdot}CH(CH_3)_2]_2$, m. p. 36—38°, readily splitting up in accordance with the equation $(C_6H_5)_2C[OCH_2{\cdot}CH(CH_3)_2]_2 = (C_6H_5)_2CO + [(CH_3)_2CH{\cdot}CH_2]_2O$; 4:4′-*dihydroxytetraphenylmethane*, $(C_6H_5)_2C(C_6H_4OH)_2$, which is formed instead of the diphenoxy-compound, $(C_6H_5)_2CCl_2 + 2C_6H_5ONa = (C_6H_5)_2C(C_6H_4OH)_2 + 2NaCl$, crystallises from ethereal solution with two molecules of ether of crystallisation, and melts at 285—287°. It gives a *diacetate*, $(C_6H_5)_2C(C_6H_4OCH_3CO)_2$, m. p. 170—171°. Experiments on the action of ethyl alcohol and of 1 per cent. alcoholic solution of hydrochloric acid on benzophenone gave negative results.

Nitration of dimethoxydiphenylmethane resulted in the formation of 4:4′- and 3:3′-dinitrobenzophenones, whilst aniline split it up, forming diphenylmethylene anilide.

The action of sodium methoxide, ethoxide, and benzoxide on benzal chloride at the ordinary pressure was tried. The first and second actions proceed as described by Wicke (*Ann.*, 1857, **102**, 356), dimethoxy- and diethoxy-benzylidene being formed. From the benzoxide experiment the only substance isolated was stilbene. By heating phenol itself with benzal chloride, condensation took place as follows, $C_6H_5{\cdot}CHCl_2 + 2C_6H_5OH = C_6H_5{\cdot}CH(C_6H_4OH)_2 + 2HCl$, the substance formed being identical with 4:4′-dihydroxytetraphenylmethane (*Ber.*, 1889, **22**, 1944), and giving the same diacetyl derivative.

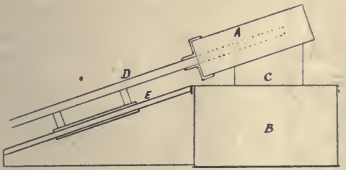
When similar experiments were made under pressure, the action was found to be quite different from the above, and may be expressed generally thus: $R'ONa + C_6H_5{\cdot}CHCl_2 = R'Cl + C_6H_5{\cdot}CHO + NaCl$. In this manner, methyl, ethyl, propyl, and benzyl chlorides were obtained.

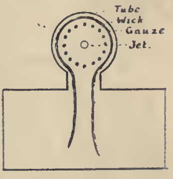
When sodium ethoxide acts on ethylene dibromide under pressure, acetylene is produced.

*98. "A kerosene oil blowpipe." By A. Richardson, Ph.D.

This blowpipe has been devised in order to utilise the combustion of kerosene oil for the production of a blowpipe flame, suitable for glass blowing and other purposes, so as to combine the advantages of a gas blowpipe while independent of a supply of gas. The need of such a blowpipe is obvious in a country like India, where gas is not always available, and where in many college laboratories not supplied with gas blowpipe work is necessarily limited to operations with the mouth blowpipe and spirit lamp.

At first it seemed possible to use one of the vegetable oils, such as cocoanut oil, by burning it in a modified form of glass blower's "tallow lamp," but the tendency of all such oils to char at the temperature of the blowpipe flame renders them useless as a continuous source of heat unless the wick is being constantly trimmed. As kerosene oil does not char, it was selected for this purpose; its combustion, however, in a lamp without a chimney requires special arrangements if it is to give a solid, steady, flame, easily regulated and completely under control of the operator, and it was only after many unsuccessful attempts that a lamp was constructed which fulfils all the requirements of the case.





As it now stands, the blowpipe consists of a metal tube, *A*, $1\frac{1}{2}$ inches long and $\frac{3}{4}$ of an inch in diameter, fixed at an acute angle above the oil holder, *B*, with which it is connected by a flattened tube or wick holder, *C*. A wick about 1 inch wide passes from *B* through *C*, round the inside of *A*, and back to *B*, leaving the central portion of the tube open. The wick is protected and kept in its place by a tube of iron wire gauze projecting beyond the wick on either side. The lower end of *A* is closed by a perforated cap, through the centre of which the blowpipe jet, *D*, passes. This is made to slide backwards and forwards on the rail, *E*, so that its position in the centre of the tube can be regulated.

A thread of asbestos dipping in the oil passes up the wick-holder and projects just in front of the wick at the open end of *A*.

To use the lamp the asbestos thread is first lighted, this furnishes a small flame at the mouth of *A*; if now the bellows be worked, combustion takes place within *A* on the surface of the gauze. The size of the flame depends on the position of the jet, since combustion is practically limited to that portion of the wick exposed to the air current, thus when the jet is pushed up to the open end, a fine-pointed flame is produced; as it is drawn back into the tube, the flame increases in size, giving a roaring flame when the whole length of the wick is exposed. On stopping the air supply the flame immediately subsides to its original size, and burns quietly at the mouth of the tube. In this way the flame is under complete control, and gives no trouble when not in use.

Experience has shown that the wick remains in good condition for a long time; in one case it was found to be only superficially blackened after the blowpipe had been in use for several weeks.

The dimensions given above are those which the author has found most useful for general purposes, but with a wick 2 inches wide, contained in a tube of 1 inch bore, a much larger and [more powerful flame is obtained, suitable for large pieces of glass blowing, although it is not so easily regulated for the production of a small flame.

The efficiency of the blowpipe has been proved by long use; with its aid all the ordinary glass blowing which before was out of the question without gas may be done.

*99. "Preliminary note on hydrides of boron." By W. Ramsay and H. S. Hatfield.

Since Jones and Taylor investigated the product of the action of hydrochloric acid on magnesium boride (*Trans.*, 1881, **39**, 213), no work seems to have been done on the subject. The ease with which gases can be liquefied and solidified by means of liquid air made it probable that an attempt to isolate boron hydride by cooling the gas from magnesium boride would be successful.

The magnesium boride obtained for the first experiment was made by heating together boron trioxide and magnesium powder in a wrought-iron crucible on an ordinary fire. The friable, black mass, treated with concentrated hydrochloric acid in a vacuous flask, gave off a gas which, when passed through a cooled wash-bottle, deposited white crystals. The hydrogen remaining in the bulb was completely removed by pumping, and on allowing the solid material to warm up it gasefied, and was collected separately. It liquefied before gasefying, and yielded about 50 c.c. of a colourless gas. The gas had a strong, fœtid odour, and burned with a bright green flame.

Its density was 19·36; for a bulb of 32·04 c.c. capacity contained 0·0432 gram of the gas at 605·9 mm. pressure and 12·2°. When sparks were passed through the gas, it was decomposed, a filament of boron joining the electrodes and conducting the current. It was found most convenient to commence the operations with a jar and spark-gap interposed, and when considerable decomposition had taken place to finish up with an "electric flame," that is, removing the Leyden jar. With the intermittent spark, the filaments were ruptured and fell; and with gas largely decomposed, they were no longer formed.

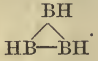
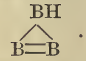
A quantitative experiment showed that the increase of volume, on decomposition, was from 2 to 3; for 19·1 c.c. of gas at 12° increased, after decomposition, to 28·1 c.c. at 11·5°. The ratio between these numbers is 2 to 2·94. This sample of gas had been exposed to the action of solid potassium hydroxide for 12 hours; it had previously passed over soda lime and phosphoric anhydride. An attempt was made to collect the boron which separated out from another sample of 26·8 c.c. on decomposition, but it was not possible to collect it free from mercury. However, it was washed out by help of ether, the ether was removed by evaporation, and the mercury was distilled off in a current of hydrogen. The residue weighed about 0·05 gram, a number not greatly differing from 0·045, the weight of the gas. The experiment was a difficult one, and could not be expected to furnish very accurate results.

These experiments render it probable that the gas consisted mainly of a compound, B_3H_3. This gas is practically insoluble in water; it is fairly stable.

The hydrogen which passed through the cooled wash-bottle burned with a green flame; a porcelain lid held in the flame was not stained with boron, as stated by Jones and Taylor. Even when the gas was passed through a red hot glass tube filled with fragments of unglazed clay, it still burned with a green flame, and the white clay was hardly stained. A quantity of the uncondensable gas was collected in a vacuous receiver (for it appeared to be somewhat soluble in water), and it was concentrated by diffusion through tobacco-pipe stems. Several hundred c.c. of the diffused gas were passed through a vessel, cooled by liquid air boiling under low pressure, and the gas was subjected to a pressure of 2 atmospheres, so as to reduce the volume occupied by the diluent hydrogen. A small amount solidified, but it was not possible to reduce the pressure much without its volatilising. The density of this sample of gas was 2·59, for 32·04 c.c. at 16·5° and 758·6 mm. weighed 0·0071 gram. On the assumption that its formula is BH_3, 26·5 per cent. of the sample consisted of that gas; the remainder was hydrogen. Of this mixture, 7·45 c.c. were sparked for 2 hours, and deposited boron on the platinum electrodes. The volume after sparking was 8·50 c.c., an increase of 1·05 c.c. Now, 26·5 per cent. of 7·45 is 1·97; hence the increase of volume was in the ratio 1·97 : 3·02, a sufficiently close approximation to 2 : 3.

Other attempts to prepare the compound B_3H_3 have not been so successful. The condensable gas has, up to now, consisted of a compound decomposable with increase of volume on addition of solid potassium hydroxide, or of concentrated sulphuric acid. The density of this sample was found to be 18·1, for the weight of 32·01 c.c. measured at 16·4° and 479·0 mm. was 0·0187. It also deposited what appeared to be boron on sparking. There appear, therefore, to be two compounds of the formula B_3H_3, one relatively stable, the second unstable and easily changed by reagents. The yields in the last case have been very poor, and the authors have not yet secured the conditions for producing the stable compound with certainty, uncontaminated by the unstable gas.

If it may be permitted to speculate regarding the hydrides of boron it is probable that the following are capable of existence:

BH_3.	$H_2B{-}BH_2$.	$H_2B{-}BH{-}BH_2$.	Saturated.
	$HB{=}BH$.	$H_2B{-}B{=}BH$.	Unsaturated.
			*cyclo*-Saturated.
			*cyclo*-Unsaturated.

The authors are inclined to suspect that the stable compound of the formula B_3H_3 is the *cyclo*-compound, to which the name *cyclo*triborene appears applicable; it is possible that triborene is the unsaturated compound, of which the formula is given above. The last formula given is the hydrogen analogue, in all probability, of the calcium, strontium and barium borides described by Moissan and Williams (*Compt. rend.*, 1897, **125**, 629).

The residues left after treatment of the magnesium boride with acid, when washed and dried, give off torrents of gas on being heated; this gas consists, for the most part, of hydrogen, and contains only a trace of boron. It no doubt results from the decomposition of solid hydroborons, but the authors have not yet succeeded in separating them from the boron with which they are mixed.

100. "On some relations between physical constants and constitution in benzenoid amines. Part II." By P. Gordan and L. Limpach.

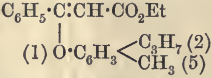
By the substitution of the benzenic hydrogen in formyl and acetyl anilides by methyl groups 38 compounds can be obtained. These compounds may be arranged, or classified, according to the number ρ of the substituting groups and also according to their relative positions —isomerides. The mode of dependence of their melting points may be seen by comparing their experimentally determined values. The mean, D, of the melting points of an isomeric series may be calculated from ρ. In each isomeric series there is at least one member the melting point of which is identical with the mean value or differs very little from it. The melting points of the others differ evenly in two directions (higher or lower) from D, and in such manner that where one compound has a melting point considerably above D, another compound, of the same series, has a melting point as much below D. For instance, in the acet-toluide series the mean D = 106·5. This is practically, the melting point of 1 : 2-acet-toluide (107°). The 1 : 3-compound melts at 65·5° and the 1 : 4 at 147°, the latter compound therefore melting 40·5° higher and the 1 : 3, 41° lower than the mean D.

The melting points are higher when both ortho-positions are occupied and lower when meta- or meta- and para-positions are occupied. The melting point seems to be mainly determined by the ortho- or neighbouring position. This observation or view is borne out by the theory of "invariants."

101. "Condensation of phenols with esters of the acetylene series. V. Homologues of benzo-γ-pyrones." By S. Ruhemann.

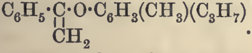
In continuation of his research, the author has studied the behaviour of the esters of chlorofumaric and phenylpropiolic acids towards thymol and carvacrol, and thus obtained the following compounds.

Ethyl β-thymoxycinnamate,



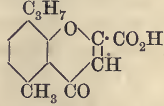
$$C_6H_5\cdot\underset{(1)\;O\cdot C_6H_3<^{C_3H_7\,(2)}_{CH_3\,(5)}}{\overset{}{C}}\!\vdots CH\cdot CO_2Et$$

the corresponding *acid* (which decomposes at 138°), and *β-thymoxystyrene,*

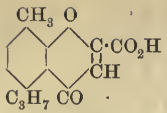


$$C_6H_5\cdot\underset{\overset{\|}{CH_2}}{C}\cdot O\cdot C_6H_3(CH_3)(C_3H_7).$$

The product of the action of thymol on ethyl chlorofumarate, *ethyl thymoxyfumarate,* yields on hydrolysis the *acid* (m. p. 215° with evolution of gas) which is condensed by strong sulphuric acid to 5-*methyl*-8-*propyl*-1 : 4-*benzopyrone-2-carboxylic acid,*



Ethyl carvacroxyfumarate, formed from carvacrol and ethyl chlorofumarate, on hydrolysis yields the corresponding *acid,* which is transformed by strong sulphuric acid into 5-*propyl*-8-*methyl*-1 : 4-*benzopyrone*-

2-*carboxylic acid,*  (m. p. 237—238° with decomposition. This, on heating, loses carbon dioxide, and yields *propylmethyl*-1 : 4-*benzopyrone* (m. p. 59—60°).

102. "Gum tragacanth." By C. O'Sullivan.

The proximate constituents of the gum have been isolated, and the following were described :

Cellulose.—The constituent insoluble in boiling water and cold dilute acid and alkalis. Treated with boiling dilute sulphuric acid, it yields arabinose and a residue of a cellulosic nature still. This residue on further treatment with ammonia and bromine gradually dissolves, leaving no residue of normal cellulose.

Soluble Gum.—A series of gum acids of the nature of the geddic acids were prepared. They are lævorotatory, however, the rotation being about as much to the left as that of the geddic acids is to the right. The acids are shown to be polyarabinan-trigalactan-geddic acids, the chief of them being $11C_{10}H_{16}O_8,3C_{12}H_{20}O_{10},C_{23}H_{36}O_{20},H_2O$. The optical activity of this acid is $[\alpha] = -88°$. Its barium salt yields 3·29 per cent. BaO, against 3·23 per cent. required. On sulphuric acid hydrolysis, it should yield 71·7 per cent. arabinose. Quantities varying between 72 and 76 per cent. moderately pure arabinose were obtained from the mixed gum acids.

Granules.—The granules, apparently starch-granules, are coloured blue by iodine, and on treatment with diastase yield dextrose, but not maltose.

Nitrogenous Matter.—No attempt was made to purify this substance. It is of much the same nature as the nitrogenous matter described in dealing with the geddic gum (*Trans.*, 1891, 59, 1061), but it does not give the same proteid reaction as that substance does.

Bassorin was not completely purified, but it was found to be an acid having $[\alpha]_D = +98°$; the neutral barium salt contains 9·2 per cent. BaO. Under the action of excess of alkalis it yields two acids, α- and β-tragacanthan-xylan-bassoric acid. The nature of this transformation will be described on a future occasion.

α-Tragacanthan-xylan-bassoric Acid.—Its preparation and purification were described; it is soluble in cold water. Its analysis led to the formula $C_{24}H_{34}O_{20},H_2O$. $[\alpha]_D = +138·6°—138·2°$; D = 4·12—4·13°. Barium, calcium and silver salts were prepared; the silver salt is the most insoluble, the calcium salt least. The neutral barium salt gave 19·21 per cent. BaO, the calcium salt 8·24 per cent. CaO, and the silver

salt 22·2 per cent. Ag. $C_{24}H_{34}O_{20}$,BaO, requires 19·24 per cent. BaO, the calcium salt 8·02 per cent., and the silver salt 24·77 per cent. In consequence of decomposition it was not possible to prepare the silver salt with any degree of satisfaction.

Digested for 20 minutes at 98° with 5 per cent. sulphuric acid, it yields a lævorotatory pentose, *tragacanthose*, $[\alpha]_D = -30°$ approx., and *xylan-bassoric acid*, $[\alpha]_D = +200°$, the barium salt yielding 22·5 per cent. BaO. The equation

$$\underset{}{C_{24}H_{36}O_{21}} + H_2O = \underset{\text{Tragacanthose.}}{C_5H_{10}O_5} + \underset{\text{Xylan-bassoric acid.}}{C_{19}H_{28}O_{17}}$$

represents the hydrolysis. $C_{19}H_{26}O_{16}O_{16}$,BaO requires 23·07 per cent. BaO.

Xylan-bassoric acid is almost insoluble in cold water, the alkaline salts are soluble, salts of the alkaline earths and most heavy metals are insoluble. Acted upon with 5 per cent. sulphuric acid, *xylose* and *bassoric acid* are obtained.

$$C_{19}H_{28}O_{17} + H_2O = \underset{\text{Xylose.}}{C_5H_{10}O_5} + \underset{\text{Bassoric acid.}}{C_{14}H_{20}O_{13}}$$

Bassoric acid is almost insoluble in cold water; in alkaline solution its optical activity was found to be $[\alpha]_D = +255°$, and the barium salt yielded 28—29 per cent. BaO. $C_{14}H_{18}O_{12}$,BaO requires 28·8 per cent. BaO.

β-Tragacanthan-xylan-bassoric acid is left behind as a crumbly mass, when the α-acid is dissolved out by cold water. On combustion it yields the same numbers as the α-acid. In alkaline solution $[\alpha]_D = +163°—164°$. The barium and calcium salts, as well as most of the salts of the heavy metals, are of very low solubility. Treated with sulphuric acid, it yields the same products as the α-acid.

In a future paper, the author hopes to be able to describe bassorin more fully, as well as its conversion into the two acids described, also the two acids themselves, and particularly the products of their hydrolysis, the sugar tragacanthose, and the final acid, bassoric acid.

103. "Optically active dimethoxysuccinic acid and its derivatives."

By T. Purdie, F.R.S., and J. C. Irvine, B.Sc.

By alkylating methyl, ethyl, and propyl tartrates by means of silver oxide and methyl iodide, the authors have obtained the corresponding optically active dimethoxysuccinates. The methyl ester is crystalline (m. p. 51°, $[\alpha]_D^{60°} = +82·52°$); the ethyl and propyl esters are liquids, giving $[\alpha]_D^{20°} = +89·96°$, $[\alpha]_D^{60°} = +85·39°$ and $[\alpha]_D^{20°} = +84·92°$, $[\alpha]_D^{60°} = +81·06°$ respectively. Dimethoxysuccinic acid is crystalline (m. p. about 151°), and gives in aqueous solution of varying concentration $[\alpha]_D^{20°} = +72·28°$ to 76·63°, in acetone +89·29° to 95·80°. The optical activity of aqueous solutions of the diamide and of various metallic salts has also been examined.

Certain regularities in the relations of the rotations of ethereal mono- and di-alkyloxysuccinates and of the corresponding acids and metallic salts were discussed, as well as Frankland's views (*Trans.*, 1899, **75**, 347) concerning the probable cause of the maximum specific rotation exhibited by the series of ethereal malates and lactates.

104. "The influence of solvents on the optical rotation of ethereal dimethoxysuccinates and tartrates." By T. Purdie, F.R.S., and W. Barbour, M.A., B.Sc.

To determine whether any change of configuration is produced by alkylating the tartaric esters with silver oxide and alkyl iodide, tartaric acid was regenerated from dimethoxysuccinic acid by heating the latter with hydriodic acid; *d*-dimethoxysuccinic acid yielded *d*-tartaric acid.

The rotations of methyl, ethyl and propyl dimethoxysuccinates in water, methyl alcohol and benzene at varying concentrations were determined, and for purposes of comparison some observations were made on solutions of the corresponding tartrates; the latter were not proceeded with further, so as to avoid interference with the work of T. S. Patterson (*Trans.*, 1901, **79**, 167, 477). In general the rotations of the former esters are influenced less by solvents than those of the latter, and in most cases the action is oppositely directed.

The authors pointed out that the direction of the effects of a solvent on the rotations of the members of a homologous series is often reversed on ascending the series, and they connect this with the corresponding reversed effect of the addition of CH_2 to successive terms.

From molecular weight determinations of the esters in water and benzene, more particularly from the results obtained with benzene solutions of the tartrates, the conclusion is drawn that the aggregation of disymmetric molecules is not a predominant factor in the influence of solvents on rotation.

To ascertain whether their observations support the theory of Patterson (*loc. cit.*) on the connection between rotation and molecular solution volume, the latter constants were calculated for a number of the solutions examined, but the results are inconclusive. In addition to the factors pointed out by Patterson which may mask this connection, the authors suggest another phenomenon, probably of frequent occurrence, which they think may interfere with the relationship in question.

ADDITIONS TO THE LIBRARY.

I. Donations.

Reports of the Royal College of Chemistry and Researches conducted in the Laboratories in the years 1848—49—50—51. Vol. II. London 1853. From John Spiller, Esq.

Bolton, H. Carrington. A select bibliography of chemistry. 1492—1897. Section VIII.—Academic dissertations. Washington 1901. From the Smithsonian Institution.

II. By Purchase.

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At the next meeting, on Thursday, June 20th, there will be a Ballot for the Election of Fellows, and the following papers will be communicated:—

"The direct union of carbon and hydrogen. Part II." By W. A. Bone and D. S. Jerdan.

"Ammonium and other imidosulphides." By E. Divers and M. Ogawa.

"Nitrilosulphates." By E. Divers and T. Haga.

"The decomposition of hydrocarbons at high temperatures." By W. A. Bone and D. S. Jerdan.

"The sugars from cellulose." By H. J. H. Fenton.

"On a theory of chemical combination." By G. Martin.

"On the occurrence of paraffins in the leaf of tobacco." By T. E. Thorpe, C.B., F.R.S., and John Holmes.

"Studies in the camphane series. Part IV." By M. O. Forster.

"On the decomposition of carbon dioxide, when submitted to electric discharge at low pressures." By J. N. Collie, Ph.D., F.R.S.

"Two new substances in lemon oil." By H. E. Burgess.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 240.

June 20th, 1901. Professor Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

Messrs. Jerdan, Blake, Eyre and Shutt were formally admitted Fellows of the Society.

The following Certificates were read for the first time:—Thomas Thorne Baker, 28, Church Road, Forest Hill, S.E.; Edwin Hobson, 3, Oxford Road, Liscard, Cheshire; Charles Harold Johnson, Beaumont, Northcote, Melbourne, Victoria, Australia; Edward Hall Miller, Common Hall, Hadleigh, Essex; Herbert Simpson Newbould Trinity Hall, Cambridge; Allan Sandford, Market Place, Ulverton.

The President announced that Dr. Armstrong had undertaken to deliver the Frankland Memorial Lecture on Thursday, October 31st, 1901.

ADDRESS TO GLASGOW UNIVERSITY.

The following Address was presented to the University of Glasgow on the occasion of the four hundred and fiftieth anniversary of its foundation:—

"The Chemical Society, as representing Chemical Science in the United Kingdom, desires to congratulate the University of Glasgow on the celebration of the Four Hundred and Fiftieth Anniversary of its foundation.

"The Chemical Society recalls with pride the fact that Members of the University of Glasgow have been most distinguished Fellows, and have contributed by their labours, some of which are among the classics of our Science, to the development of chemical learning.

"Thomas Graham, one of the Founders of our Society and our first President, was the most illustrious of the pupils of Thomas Thomson, whose name is honourably connected with Chemistry as head of one of the first Schools of Practical Chemistry established in this Kingdom, a school which he inaugurated within your walls.

"Thomas Anderson, an honoured name with you as a teacher, who was among the earliest to cultivate with an energy and zeal eminently characteristic the newly developed domain of Organic Chemistry, was for many years one of the most active of our Fellows.

"We sincerely trust that your University may continue to flourish in the future as in the past, and that its efforts to foster and promote the Science which we represent may be as successful in the years to come as they have been since the days of Black.

J. EMERSON REYNOLDS, *President.*
WILLIAM A. TILDEN, *Treasurer.*
WYNDHAM R. DUNSTAN,
ALEXANDER SCOTT,
RAPHAEL MELDOLA, } *Secretaries.*"

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:—Ormsby Gore Adams, Guy Ashwell, Thomas Aspinall, William George Aston, Hubert Haigh Barker, Edwin Sloper Beaven, Fred Bedford, Joseph Samuel Bridges, B.Sc., Arthur Crabtree, George Dean, M.A., Thomas H. J. Eling, B.A., Edward K. Hanson, B.A., Frederick Thomas Harry, Edward Horton, Christopher G. Kiddell, B.A., Robert Tabor Lattey, B.A., Adolf L. F. Lehmann, B.Sc., Ph.D., William Lowson, B.Sc., F. G. Macdonald, Daniel McLaren, B.Sc., Frank Oram, John Powell, B.Sc., John Edward Purvis, M.A., James Bertram Russell, B.Sc., Thomas Sandford, Samuel Edward Sheppard, Gerald T. S. Sichel, Andrew Biggam Smith, John Davidson Spence, Arnold Rowsby Tankard, George William G. Tatam, William Arthur Whitton, James Whittle, and Duncan R. Wilson, B.A.

Of the following papers, those marked * were read.

*105. "The direct union of carbon and hydrogen. Part II." By
W. A. Bone and D. S. Jerdan.

The authors have already shown (*Trans.*, 1897, 71, 41) that carbon and hydrogen combine at 1200°, forming a saturated hydrocarbon; and also that when the electric arc is passed between carbon terminals in an atmosphere of hydrogen, a saturated hydrocarbon is produced in addition to acetylene, the formation of each continuing until a definite equilibrium between acetylene, the saturated hydrocarbon, hydrogen, and carbon vapour is established. It was then provisionally assumed that the saturated hydrocarbon produced both at 1200° and in the arc is methane.

Further experiments have been made in which the saturated hydrocarbons in question have been separated from the large excess of hydrogen (by means of palladium), and also, in the case of the arc gases, from the acetylene simultaneously produced. Analyses of the residual saturated hydrocarbons, mixed with whatever nitrogen was contained in the original hydrogen employed, have shown that whereas the gas obtained by the direct action of hydrogen upon solid carbon at 1200° consists of methane only, the saturated hydrocarbons produced in the arc consist of methane with one of its homologues, which further investigation has shown to be ethane.

The authors are able to show further that in the arc methane and ethane are produced simultaneously, and at rates which bear a constant ratio to one another throughout an experiment, until a definite equilibrium is reached. By calculation from the results of the previous experiments, interpreted in the light of later work, the proportions between the various hydrocarbons and hydrogen when this equilibrium is attained are shown to be:

Hydrogen..........................	90 to 91	per cent.
Acetylene	8 to 9	„
Methane	1·25	„
Ethane	0·25	„

*106. "Ammonium and other imidosulphites." By E. Divers and M. Ogawa.

The authors have already called attention to the occurrence of ammonium imidosulphite amongst the products of the decomposition of ammonium amidosulphite, and have given some account of the salt (*Proc.*, 1900, 16, 113). They now separate it by dissolving it out with warm 90 per cent. alcohol, after having used 95 per cent. alcohol to extract some other crystalline matter and the red substance. By working in this way, the imidosulphite is obtained at once almost pure, requiring only to be washed with alcohol. It forms minute, very thin, glistening prisms, somewhat deliquescent, neutral to litmus and of mild sulphurous taste. Heated in the dry state, most of it decomposes, but a little occurs in the sublimate along with pyrosulphite. The residue left on heating it up to 150° consists of sulphur, sulphate, and imidosulphate. The salt is very soluble in water, and slowly decomposes in solution. Boiled with hydrochloric acid, it yields sulphur, sulphur dioxide, and amidosulphuric acid, the sulphur and sulphur dioxide representing, no doubt, decomposed thiosulphate, $2NH(SO_2NH_4)_2 + OH_2 = 2NH_2SO_3NH_4 + S_2O_3(NH_4)_2$. Ammonium imidosulphite gives a barium precipitate soluble in hydrochloric acid. Potassium imidosulphite and barium ammonium imidosulphite have been prepared, and are crystalline soluble salts.

*107. "Nitrilosulphates." By E. Divers and T. Haga.

Ammonium nitrilosulphate cannot be obtained by the sulphonation of ammonia, for the imidosulphate which is the product of the union of sulphur trioxide with ammonia is decomposed by heat only at a very high temperature, and then is radically broken up without giving any nitrilosulphate. The sulphonation of a nitrite first into hydroximidosulphate and then into the nitrile is therefore the only way open. The ammonium and potassium salts were obtained by Fremy (1845), and a potassium sodium salt, $SO_3Na{\cdot}N(SO_3K)_2$, by Raschig (1887). The ammonium salt, as it has the composition of $4NH_3 + 3SO_3$, is a very interesting salt, the existence of which had been forgotten. Sodium nitrilosulphate is so very soluble that it has not been isolated before. It can be obtained by passing sulphur dioxide into the most concentrated solution possible, containing sodium nitrite and sodium carbonate in the ratio of two molecules of the former to three of the latter salt, until the new salt begins to crystallise out. It occurs in small, sparkling, short, thick prisms containing $5H_2O$, and is exceedingly unstable. It is neutral to litmus. By dissolving the salt in concentrated, faintly alkaline solution of barium chloride, a precipitate is obtained, flocculent at first, but becoming crystalline and dense, of barium or barium sodium nitrilosulphate.

*108. "The decomposition of hydrocarbons at high temperatures. Preliminary note." By W. A. Bone and D. S. Jerdan.

For some months past the authors have been studying the decomposition of various hydrocarbons at a temperature of about 1150°. Since methane is the only hydrocarbon produced by the direct combination of carbon and hydrogen at 1200°, it seemed probable that any hydrocarbon would, at this temperature, be decomposed, yielding ultimately carbon, hydrogen, and a small percentage of methane. So far the authors have only studied the decomposition of methane and acetylene in detail, but the recent publication of a paper "Ueber pyrogenetische Reactionen organischer Substanzen" by W. Ipatiew (*Ber.*, 1901, **34**, 596), in which he announces his intention to investigate the decomposition of hydrocarbons at high temperatures, makes it desirable that they should publish this note.

The method adopted by the authors, which will be described in detail in a future communication, consists in admitting the pure hydrocarbon into a vacuous, glazed porcelain tube (length 60 cm., internal diameter 12 mm., capacity about 65 c.c.), nearly the whole length of which has been previously heated to about 1150° in a specially designed Fletcher furnace. The experimental tube is properly jacketed so as to prevent any diffusion of furnace gases into it. The temperature, which can be maintained practically constant for several hours, was ascertained by means of a Roberts-Austen electrical pyrometer. After the gas under investigation has been subjected to the high temperature for a definite time, it is quickly pumped out into tubes over mercury.

Acetylene is very rapidly decomposed at 1150°; after one minute not more than 10 per cent., and after five minutes only a mere trace of it remains. Considerable quantities of a saturated hydrocarbon, which subsequent examination has shown to be methane, are formed during the early stages of the decomposition, and afterwards this methane is slowly, though never completely, resolved into its elements. Neither benzene nor ethylene are formed at any stage of the decomposition, and, after the final disappearance of acetylene, the gaseous products contain hydrogen and methane only. Carbon is liberated during the early stages as 'lamp-black,' which doubtless arises from the rapid decomposition of the acetylene, but afterwards it is only deposited on the inner surface of the tube in a form much resembling 'gas carbon.'

The following figures show the percentage composition of the gases obtained in a series of experiments in which the time of heating varied from 1 minute to 3 hours:

Time	1 min.	5 mins.	15 mins.	1¼ hours.	3 hours.
Acetylene	10·0	trace	nil	nil	nil
Methane	16·0	21·5	16·0	7·75	3·0
Hydrogen	74·0	88·5	84·0	92·25	97·0

Methane is resolved into its elements at 1150° more rapidly than would be generally supposed. The decomposition, however, only occurs at the surface of the containing tube, where the carbon is deposited in a form much resembling 'gas carbon' in appearance. At no stage of the decomposition was it possible to detect the formation of acetylene, ethylene or any other unsaturated hydrocarbon. A careful examination of the gas left after 15 minutes' heating has shown that it contains no other saturated hydrocarbon then methane. The following figures indicate the percentage composition of the gas obtained at the end of 5, 15, and 30 minutes respectively, leaving out of the reckoning any small amount of nitrogen it contained :

Time..............	5	15	30 minutes.
Methane	37·5	12·25	6·6
Hydrogen.........	62·5	87·75	93·4

The authors are now completing a series of experiments on ethane, and then propose to extend the research to other typical hydrocarbons, and to temperatures other than 1150°.

*109 "Note on the sugars from cellulose." By Henry J. H. Fenton.

In several previous communications (Fenton and Gostling, *Trans.*, 1898, **73**, 554; 1899, **75**, 423; 1901, **79**, 361, 807) it has been shown that various forms of 'cellulose' (such as filter paper and cotton) give considerable yields of the chloro- or bromo-derivatives of methylfurfural when they are heated with dry hydrogen chloride or bromide dissolved in an appropriate solvent. It was further shown than the formation of the bromo-derivative in any notable quantity is indicative of the presence of a *ketohexose* nucleus or grouping, and the existence of one or more such groupings in 'cellulose' was consequently inferred. Recent experiments indicate that the same observations apply also to the *chloro*-derivative.

After treatment of cellulose in this manner with dry hydrogen chloride and complete removal of the methylfurfural derivative by washing repeatedly with ether, a dark brown residue is left which, in the case of filter-paper, still shows a fibrous structure and amounts to about 90 per cent. of the material taken. If this residue is digested with warm water, a solution is obtained which gives all the reactions of *dextrose*. It is strongly dextrorotatory and with phenylhydrazine acetate, on heating, yields *glucosazone* (m. p. 204—206°. $N = 15·83$, theory requiring 15·64 per cent.). On evaporating the solution to small bulk in a vacuum and adding alcohol, a syrup is at once precipitated, which solidifies on standing, and the solution continues to deposit crystalline crusts after a time. Mannose appears to be excluded from the fact that phenylhydrazine gives no precipitate in the cold even after standing for several hours.

Fifty grams of Swedish filter-paper were treated in the manner above described, the solvent used being carbon tetrachloride, and the resulting chloromethylfurfural estimated by weighing the crystals. The residue was then extracted with water and the dextrose estimated by means of Fehling's solution. The results gave chloromethylfurfural 3·1 grams, and dextrose 1·57 grams. At first sight therefore it would appear that the methylfurfural derivative is produced in excess. But it is found that when dextrose is treated in the same manner, a considerable portion is destroyed, leaving a black residue. A blank experiment was made with 5 grams of dextrose under exactly similar conditions, with the result that the carbon tetrachloride extract weighed only 0·01 gram, and the residual sugar 2·2 grams. If it be assumed that the dextrose resulting from the action on cellulose is destroyed to a similar extent, the calculated amount of this sugar produced in the first experiment mentioned would be 3·54 grams. This, it will be seen, is approximately the quantity required (3·86 grams) on the assumption that the chloromethylfurfural and dextrose are produced in *equal molecular proportions* (144·5 : 180).

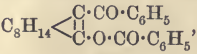
These facts appear to be of especial interest in relation to the recent work of Skraup and König (*Ber.*, 1901, **34**, 1115), in which it is stated that the cellulose acetate obtained by the action of acetic anhydride and concentrated sulphuric acid on filter paper is an *octoacetyl biose* and that this on hydrolysis yields 'cellose,' $C_{12}H_{22}O_{11}$.

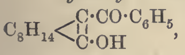
A simple explanation of the results above mentioned would be afforded if it be assumed that this 'cellose' (and its antecedent) contains both ketohexose and aldohexose residues, so that the action of hydrogen chloride could be represented by one of the following equations:

$C_{12}H_{20}O_{10} + HCl = C_6H_5O_2Cl + C_6H_{12}O_6 + 2H_2O$

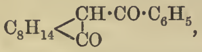
$C_{12}H_{22}O_{11} + HCl = C_6H_5O_2Cl + C_6H_{12}O_6 + 3H_2O$. If the brown residue which remains after extracting the chloromethylfurfural and sugar be dried and again treated with dry hydrogen chloride as before, a further yield of both products is obtained and experiments are being made to ascertain to what extent this treatment may be repeated, and what is the nature of the final residue.

*110. "Studies in the camphane series. Part IV." By M. O. Forster.

1-*Benzoxy-2-benzoylcamphene*,  $C_8H_{14}\Big<\begin{matrix} C\cdot CO\cdot C_6H_5 \\ \| \\ C\cdot O\cdot CO\cdot C_6H_5 \end{matrix}$, prepared by the action of benzoyl chloride on the sodium derivative of camphor dissolved in toluene, crystallises from alcohol in colourless, highly refractive prisms and melts at 144°; a 4 per cent. solution in chloroform has the specific rotation $[\alpha]_D = +189\cdot7°$.

1 - *Hydroxy - 2 - benzoylcamphene* (*enolic α - benzoylcamphor*),  $C_8H_{14}\Big<\begin{matrix} C\cdot CO\cdot C_6H_5 \\ \| \\ C\cdot OH \end{matrix}$, obtained by hydrolysing the foregoing substance with alcoholic potash, crystallises from alcohol in flattened octahedra and melts at 89°; a 2 per cent. solution in chloroform gave $[\alpha]_D = +281\cdot1°$. It dissolves in sodium carbonate, and an alcoholic solution developes immediately an intense purple coloration with ferric

chloride; cold concentrated sulphuric acid and boiling formic acid convert it into the ketonic modification, a change which also proceeds spontaneously when the substance is dissolved in organic media, the transformation into the ketone being accelerated by addition of piperidine or by exposure to sunlight. The *sodium*, *copper*, and *ferric* derivatives are crystalline, and are freely soluble in organic liquids; the *phenylurethane* derivative melts at 117°, and the *acetyl* derivative, which crystallises from alcohol in lustrous, rectangular plates, melts at 107°.

a-Benzoylcamphor,  $C_8H_{14}\Big\langle\begin{array}{l}CH\cdot CO\cdot C_6H_5\\ \,|\\ CO\end{array}$, produced on boiling a solution of the isomeride in formic acid, crystallises from alcohol in colourless, transparent prisms melting at 87—88°; a 2 per cent. solution in chloroform gave $[\alpha]_D = +125{\cdot}0°$. The alcoholic solution remains indifferent to ferric chloride at first, but a green colour is rapidly developed, and changes ultimately to bluish-violet. Fusion converts the ketone into the enolic isomeride, and the specific rotation of a solution in chloroform gradually increases until $[\alpha]_D = +216°$, the value to which the optical activity of the enol diminishes.

*111. "On the decomposition of carbon dioxide, when submitted to electric discharge at low pressures." By J. N. Collie, Ph.D.

During some experiments that were being made on the relative resistance of carbon dioxide in a vacuum tube to the electric spark from an induction coil, it was noticed that the resistance varied considerably. At the same time, the colour of the incandescent gases at the negative electrode was seen to change. In order to ascertain what changes had taken place in the composition of the gas after sparking, the contents of the vacuum tube were pumped out and analysed. It was found that considerable decomposition had occurred into carbon monoxide and oxygen, $2CO_2 = 2CO + O_2$. A series of experiments gave the following results. When carbon dioxide at 5 mm. pressure is sparked in an ordinary vacuum tube for 10 minutes, 63 per cent. of the gas is decomposed, and when sparked for 5, 3, 2½, 1, and even ½ a minute as much as 58—60 per cent. decomposition occurs. In 15 seconds one experiment showed that 48 per cent. was decomposed, whilst in some others when the gas was sparked for 10 seconds at 10, 3, and 1 mm. pressure, 32, 55, and 65 per cent. respectively was decomposed. Most of these experiments were made with platinum electrodes. Aluminium electrodes gave a rather higher amount of decomposition, whilst with an electrodeless tube only 50 per cent. suffered decomposition after 1 minute sparking.

Another interesting observation was that if the platinum electrodes are allowed to become red-hot, recombination at once occurs between the carbon monoxide and oxygen till the gas which remains, instead of containing the products of decomposition of 60 to 70 per cent. of the carbon dioxide, is almost pure carbon dioxide.

Under electrical strain, therefore, at low pressures, carbon dioxide is a very unstable gas, but when the products of decomposition come in contact with red-hot platinum wire recombination occurs. Carbon monoxide, even after 20 minutes' sparking, seemed almost unchanged, and gave only a faint turbidity with baryta water. When a mixture of carbon dioxide and hydrogen is sparked at reduced pressures small quantities of a gas which seems to be methane are formed, but under no conditions could formaldehyde be detected. It is probable that the methane is formed by the action of hydrogen on carbon monoxide.

*112. "Halogen derivatives of *p*-cymene from substituted nitrocamphanes." By M. O. Forster and W. Robertson.

The oil which accompanies the conversion of 1 : 1-bromonitrocamphane into the anhydride has been identified as bromo-*p*-cymene [$CH_3 : Br : C_3H_7{}^{\beta} = 1 : 2 : 4$].

The *anhydride* of 1 : 1-chloronitrocamphane, prepared by dissolving that substance in cold concentrated sulphuric acid, crystallises from alcohol in colourless opaque prisms, and melts at about 230°; chloro-*p*-cymene is formed during the production of this compound. The *isomeride*, $C_{10}H_{14}ONCl$, obtained by the action of an alcoholic solution of hydrochloric acid, crystallises in transparent, six-sided plates and melts at 248°; it forms a *benzoyl* derivative which melts at 166°.

The *hydroxylamino*-derivative, $C_{10}H_{17}O_2N_2Cl$, prepared from either compound by the action of alcoholic hydroxylamine, melts at 187°; the *benzoyl* compound melts at 164°.

The *nitro*-derivative of the anhydride melting at 248° crystallises in flat prisms, which melt at 71—72°; reduction with zinc and acetic acid regenerates the anhydride.

113. "On a theory of chemical combination." By G. Martin.

Atoms are complex structures analogous to a benzene nucleus which in their ordinary state are incapable of acting on each other, but if by some cause the atomic ring is broken, the atoms become capable of acting together. In this state they are said to be "ionised." Chemical action will only take place of its own accord when the rate of variation of ether strain experienced by a molecule, produced by the approach and recedence of neighbouring molecules, is of such a rate as to coincide with an internal rate of vibration of an atom or molecule.

The atoms thus become ionised. The dissociation of gaseous molecules is controlled by two circumstances: (*a*) The gradual increase of temperature, by increasing the velocity of the atoms in the molecule, may cause it to decompose of its own accord; (*b*) if the rate of vibration of ether strain happens to coincide with the rate of vibration of the molecule, the dissociation will occur long before cause (*a*) of itself would cause decomposition.

In dissociation the atoms need not necessarily be ionised. The rapid increase of velocity of reaction with the temperature is due to the coincidence of the time rates of atomic vibration and the rate of variation of ether strain.

If two gaseous molecules, A and B, act on each other at (say) $t°$, then the same reaction will also take place at higher temperatures—$t'°$ and $t''°$—the condition being that at $t°$ the rate of variation of ether strain is approximately equal in value to the rate of vibration of the atoms of the molecule. But at $t'°$ and $t''°$ the rate of variation of ether strain is respectively double or treble the rate of atomic vibration. It may happen, however, that the products of the change are incapable of existing at these temperatures. The atoms will, however, be ionised at each of the ranges $t°$, $t'°$, and $t''°$, no matter whether any reaction takes place or not. At intermediate temperatures no reaction will take place. In certain cases we have experimental evidence of such ranges of temperature, silicon hexachloride, Si_2Cl_6, for example, is stable enough at the ordinary temperature, but above 300° its vapour begins to dissociate, and at 800° it is entirely decomposed. If, however, the temperature be raised rapidly above 1000° no decomposition of the substance occurs. The substance, therefore, is stable above 1000° and below 350°, but will not exist at intermediate temperatures.

The occurrence of these temperature ranges may be obscured by the fact that the products of the reaction may exist continuously from one range to the other.

A reaction will only proceed to completion when the rate of variation of ether strain necessary to cause the molecules to react together does not also induce the products of the change to decompose. Complete reactions occur only very seldom, as a complex molecule has so many modes of vibration that it is not difficult for it to be affected at almost any temperature.

114. "On the occurrence of paraffins in the leaf of tobacco." By T. E. Thorpe, C.B., F.R.S., and J. Holmes.

In connection with the working of the Revenue Act, which imposes a limit upon the amount of oil which may be present in manufactured tobacco, the authors have had occasion to study the nature of the material which is extracted from tobacco by 'petroleum-ether.' In the extract thus obtained, they have discovered the presence of two paraffins, *hentriacontane*, $C_{31}H_{64}$, melting at 67·8—68·5°, and *heptacosane*, $C_{27}H_{56}$, melting at 59·3—59·8°, which are present in the leaf in about equal amounts to the extent, in the aggregate, of rather more than 1 part per 1000.

In Kentucky and Virginia leaf, the mixed hydrocarbons, in three separate preparations, had the following melting points: western leaf, 63·0—63·8°; "wrappers," 63·5—64·0°; "fillers," 63·7—65·0°. The authors are of opinion that the snow-white substance of satiny lustre extracted from Kentucky tobacco by Kissling (*Ber.*, 1883, **16**, 2432), which he found to melt at 63·0° and which he regarded as probably an impure mellissyl mellisate, and the substance of similar appearance found by him among the constituents of tobacco-smoke, melting at 64·5°, but which he regarded as a hydrocarbon, are in reality the same products, and identical with the mixture of the two paraffins, the heptacosane, $C_{27}H_{56}$, and hentriacontane, $C_{31}H_{64}$, of Krafft, which the authors have found to be present in all the American tobaccos examined by them.

115. "Two new substances in lemon oil." By H. E. Burgess.

If 3 or 4 litres of the terpenes obtained during the distillation of the lemon oil are well shaken with a cold solution of sodium metabisulphite, a small quantity of a crystalline compound is formed which can be separated and washed with alcohol and ether. This on being decomposed in the usual way gives an aldehyde of which the constants are very different from those of citral:—boiling point, 80—85° at 15 mm.; optical rotation, $+0°{\cdot}30'$; refractive index, 1·4314 at 20°.

It has an odour resembling cocoanut oil. On shaking the aldehyde with hydrogen peroxide and caustic soda solution it is at once polymerised into a solid form which can be recrystallised from alcohol.

It forms an oxime melting at 35°, and on oxidation with potassium permanganate it gives an oily acid; from the ammonium salt the silver, copper, and magnesium salts have been prepared and analysed.

Apparently the same aldehyde exists in orange oil, but was not found in the terpenes as in the case of lemon oil.

A crystalline substance was obtained by shaking together one litre each of acetone and lemon oil and then adding about 200 c.c. of water, when it separates into two layers; the lower portion was separated and allowed to stand for 24 hours, when small crystals were formed in the globules of oil floating on the surface; these were filtered off and recrystallised from alcohol and ether.

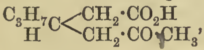
Several such separations may be made from each quantity of oil, but the total yield from one litre was extremely small. The crystals so obtained melted at 145°. They are sparingly soluble in alcohol, the solution having a marked blue fluorescence.

Several combustions have been made of the recrystallised substance which forms a crystalline dibromide and is oxidised to oxalic acid and carbonic acid.

116. "Preparation and properties of 2 : 6-diketo-4-isopropylhexamethylene (2 : 6-dihydroxy-4-isopropyldihydroresorcinol)." By A. W. Crossley.

Ethyl 2 : 6-*diketo*-4-iso*propylhexamethylene*-3-*carboxylate*, obtained by the condensation of *iso*butylideneacetone and ethyl malonate, separates from a mixture of benzene and light petroleum in small needles melting at 101°. When boiled with sodium carbonate or potassium hydroxide solution it yields :

2 : 6-*Diketo*-4-iso*propylhexamethylene*, $^{C_3H_7}_{H}C<\begin{matrix}CH_2\cdot CO\\ CH_2\cdot CO\end{matrix}>CH_2$, which crystallises from dilute alcohol, with $1H_2O$, in well formed needles melting at 67·5°. Its constitution is proved by its method of formation and because on oxidation with sodium hypobromite it yields *β-iso*propylglutaric acid. The *silver* salt is an insoluble white precipitate and the *dioxime* separates from dilute methyl alcohol in clusters of stumpy needles melting somewhat indefinitely about 145°.

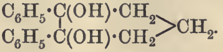
When hydrolysed with barium hydroxide diketo*iso*propylhexamethylene is converted quantitatively into *β*-iso*propyl-γ-acetylbutyric acid*,  $^{C_3H_7}_{H}C<\begin{matrix}CH_2\cdot CO_2H\\ CH_2\cdot CO\cdot CH_3\end{matrix}$, which is an almost colourless oil boiling at 195° (39 mm.).

117. "Action of bromine on the three toluene azophenols." By J. T. Hewitt and J. N. Tervet.

In continuation of the work of one of the authors and his pupils on the substitution of oxyazo-compounds, the bromination of the three tolueneazophenols has now been studied. In glacial acetic acid solution, sodium acetate being present, toluene azodibromophenols result in all these cases, the reactions being quite analogous to those observed with phenol itself. Metatolueneazophenol brominates smoothly only if the solution in acetic acid is well cooled whilst the bromine is added.

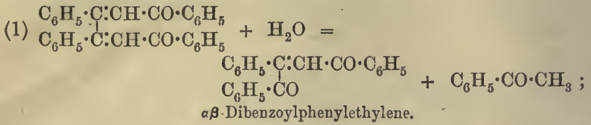
The following substances have been prepared: o-*tolueneazodibromophenol*, m. p. 121°; *ethyl ether*, m. p. 95°; *acetyl* derivative, m. p. 153°; *benzoyl* derivative, m. p. 169°; m-*tolueneazodibromophenol*, m.p. 129°; *ethyl ether*, m. p. 88°; *acetyl* derivative, m. p. 118°; *benzoyl* derivative, m. p. 141°; p-*tolueneazophenol*, m. p. 137°; *ethyl ether*, m. p. 95°; *acetyl* derivative, m. p. 148°; *benzoyl* derivative, m. p. 114°.

118. "Reduction of αγ-dibenzoylpropane and dibenzoyldiphenylbutadiene." By F. R. Japp, F.R.S., and A. C. Michie, B.Sc.

By the action of sodium on an ethereal solution of αγ-dibenzoylpropane, $C_6H_5\cdot CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot C_6H_5$, floating on water, J. Wislicenus and Kuhn (*Annalen*, 1898, **302**, 221) obtained a "pale yellow oil" which they regard as the cyclic pinacone, 1 : 2-*diphenyl*-1 : 2 *dihydroxy*cyclo*pentane*,  $\left.\begin{array}{l} C_6H_5\cdot C(OH)\cdot CH_2 \\ \quad\;\; | \\ C_6H_5\cdot C(OH)\cdot CH_2 \end{array}\right> CH_2$. The present authors show that this oil is, in reality, a very complex mixture. The pinacone, which when pure forms colourless needles showing oblique extinction and melting at 103—104·5°, is contained in it to the extent of about 50 per cent. From glacial acetic acid the pinacone is deposited in large, sparingly soluble crystals of the formula $C_{17}H_{18}O_2,C_2H_4O_2$, in which form it may be separated from the other substances present. A quantitative yield of it may be obtained by the reduction of dibenzoylpropane in hot aqueous alcoholic solution with aluminium amalgam. Oxidised with chromium trioxide, it regenerates dibenzoylpropane. In addition to the pinacone, the "pale yellow oil" contains, along with other substances, a small quantity of *αε-diphenyl-αε-dihydroxypentane*, $C_6H_5\cdot CH(OH)\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH(OH)\cdot C_6H_5$, lustrous, slender, six-sided prisms showing straight extinction and melting at 84—88° to a turbid liquid which clears at 92°. A better although still unsatisfactory yield of the latter substance is obtained by reducing dibenzoylpropane in boiling alcoholic solution with sodium.

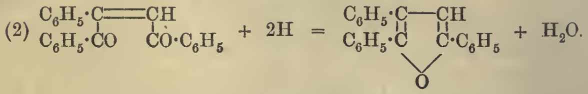
By reducing the "pale yellow oil" with hydriodic acid, Wislicenus and Kuhn prepared a hydrocarbon melting at 108° to which they assign the constitution of a 1 : 2-*diphenyl*cyclo*pentane*. The authors find that this supposed 1 : 2-diphenyl*cyclo*pentane is a highly polymerised substance which does not boil even at 340° under a pressure of 12 mm., whereas the known 1 : 2-diphenyl*cyclo*pentane (m. p. 47°) obtained from anhydracetonebenzil (Japp and Burton, *Trans.*, 1887, **51**, 423; Japp and Lander, *ibid.*, 1897, **71**, 128 and 131), the existence of which has been overlooked by Wislicenus and Kuhn, boils at 189° under a pressure of 12 mm. The authors give a further proof of the constitution of the latter 1 : 2-diphenyl*cyclo*pentane by oxidising it to αγ-dibenzoylpropane.

J. Wislicenus and Lehmann (*Annalen*, 1898, **302**, 214), by reducing dibenzoyldiphenylbutadiene with hydriodic acid, obtain, along with other products, a substance melting at 92—94° to which they assign the formula $C_{20}H_{14}O$. The authors find that this compound has in reality the formula $C_{22}H_{16}O$, and is 2 : 3 : 5-*triphenylfurfuran* (Japp and Klingemann, *Trans.*, 1890, 57, 663), and that *acetophenone* is simultaneously formed, the reaction taking place as follows:



$$(1)\ \begin{array}{l} C_6H_5\cdot C{:}CH\cdot CO\cdot C_6H_5 \\ C_6H_5\cdot C{:}CH\cdot CO\cdot C_6H_5 \end{array} + H_2O = \begin{array}{l} C_6H_5\cdot C{:}CH\cdot CO\cdot C_6H_5 \\ C_6H_5\cdot CO \end{array} + C_6H_5\cdot CO\cdot CH_3\ ;$$

αβ-Dibenzoylphenylethylene.



(2)

For the sake of simplicity, the symmetrical formula for dibenzoyldiphenylbutadiene has been employed; but the validity of the explanation is quite independent of this.

The various papers on the condensations of benzil with ketones published by one of the authors, conjointly with others, have, with one exception, been overlooked by J. Wislicenus and his pupils, and the errors into which they have fallen are in part attributable to this cause.

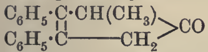
119. "Homologues of anhydracetonebenzil." By F. R. Japp, F.R.S., and A. N. Meldrum, B.Sc.

The authors find that under the influence of potassium hydroxide benzil condenses with homologues of acetone of the general formulæ $CH_2R\cdot CO\cdot CH_3$, $CHR_2\cdot CO\cdot CH_3$, $CH_2R\cdot CO\cdot CH_2R$, and $CHR_2\cdot CO\cdot CH_2R$, to form homologues of anhydracetonebenzil (*diphenyl*cyclo*pentenolone*), $\begin{array}{l} C_6H_5\cdot C{=\!=}\overset{\alpha}{C}H \\ C_6H_5\cdot C(OH)\cdot \underset{\beta}{CH_2} \end{array}\!\!>\!CO$. In naming these compounds the CH group in the pentacarbon ring is distinguished as the α- and the CH_2 group as the β-position. Thus benzil and methyl ethyl ketone yield *α-methylanhydracetonebenzil*, $\begin{array}{l} C_6H_5\cdot C{=\!=}C(CH_3) \\ C_6H_5\cdot C(OH)\cdot CH_2 \end{array}\!\!>\!CO$ (large, flat, lozenge-shaped crystals melting at 118°), and *β-methylanhydracetonebenzil*, $\begin{array}{l} C_6H_5\cdot C{=\!=}CH \\ C_6H_5\cdot C(OH)\cdot CH(CH_3) \end{array}\!\!>\!CO$ (prisms, melting at 180°)—the latter already prepared by Japp and Burton (*Trans.*, 1887, 51, 431)—whilst at the same time an open-chain compound, *desylene-methyl ethyl ketone*, $\begin{array}{l} C_6H_5\cdot C{:}CH\cdot CO\cdot C_2H_5 \\ C_6H_5\cdot CO \end{array}$ (m. p. 157°), is formed. The latter substance is more readily obtained by boiling β-methylanhydracetonebenzil with glacial acetic acid, and, on the other hand, is reconverted into the β-compound by heating at 300—320°.

The authors show that the sparingly soluble monalkyl homologues of anhydracetonebenzil prepared by Japp and Burton by heating a mixture of benzil and homologues of acetone with aqueous potassium hydroxide, belong to the β-series, and that readily soluble α-isomerides, overlooked by these authors, are formed in small quantity at the same time. By using cold alcoholic potassium hydroxide as a condensing agent, the α-compounds may be obtained in larger quantity. All the α-compounds are distinguished by forming benzylidene derivatives when treated with benzaldehyde and alcoholic potassium hydroxide.

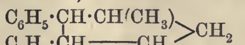
With benzil and alcoholic potassium hydroxide, α-methylanhydracetonebenzil yields *α-methylanhydracetonedibenzil*, $C_{32}H_{26}O_4$ (dimorphous: silky needles, m. p. 185°; and warty crystals, m. p. 194°), which is obtained in the form of a complex potassium salt, $C_{32}H_{25}O_4K,C_{32}H_{26}O_4,4C_2H_5\cdot OH$. The sodium salt may be obtained directly from benzil and methyl ethyl ketone by condensation with alcoholic sodium ethoxide. α-Methylanhydracetonedibenzil is ethylated by boiling it with alcohol and sulphuric acid, yielding the compound $C_{32}H_{25}(OC_2H_5)O_3$ (short needles, melting at 250°).

Both α- and β-methylanhydracetonebenzil are transformed, by brief boiling with hydriodic acid, into the same *methyldiphenyl*cyclo*pentenone*,



$$\left.\begin{array}{l} C_6H_5\cdot C\cdot CH(CH_3) \\ \quad\ \ \| \\ C_6H_5\cdot C\text{———}CH_2 \end{array}\right>CO$$

(faint yellow, oblique, flat prisms or plates, m. p. 77—78°), which yields a *phenylhydrazone*, $C_{24}H_{22}N_2$, melting at 145—152°. By boiling α-methylanhydracetonebenzil for 5 hours with hydriodic acid and red phosphorus, the methyldiphenyl*cyclo*pentenone, which is first formed, is in its turn reduced to 1-*methyl*-2:3-*diphenyl*cyclo*pentane*,

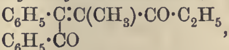


$$\left.\begin{array}{l} C_6H_5\cdot CH\cdot CH(CH_3) \\ \quad\ \ | \\ C_6H_5\cdot CH\text{———}CH_2 \end{array}\right>CH_2$$

(m. p. 62—63°), already obtained by Japp and Murray (*Trans.*, 1897, 71, 153) by the reduction of α-anhydrobenzillævulic acid, the carboxyl group being eliminated in the latter case.

By boiling with slightly diluted sulphuric acid, or with glacial acetic acid, α-methylanhydracetonebenzil yields a dehydration product, $C_{36}H_{28}O_2$ (m. p. 230°, with evolution of gas). β-Methylanhydracetonebenzil, when heated with formic acid, gives the same product.

In addition to the foregoing, the following compounds have been prepared: *Benzylidene-α-methylanhydracetonebenzil*, m. p. 225°; *α-desylene-ethyl ethyl ketone*,



$$\begin{array}{l} C_6H_5\cdot C{:}C(CH_3)\cdot CO\cdot C_2H_5 \\ \quad\ \ | \\ C_6H_5\cdot CO \end{array}$$

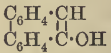
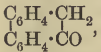
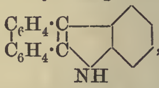
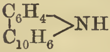
, m. p. 128°, converted, on heating, into $\alpha\beta$-dimethylanhydracetonebenzil, m. p. 150°; *$\beta\beta$-dimethylanhydracetonebenzil*, m. p. 181°; *α-ethylanhydracetonebenzil*, m. p. 114°, and its *benzylidene* derivative, m. p. 178°

aββ-trimethylanhydracetonebenzil, m. p. 131°; *a-propylanhydracetonebenzil*, m. p. 89°, and its *benzylidene* derivative, m. p. 166°; *β-propylanhydracetonebenzil*, m. p. 152°; *aβ-diethylanhydracetonebenzil*, m. p. 113—114°; *a-amylanhydracetonebenzil*, m. p. 57°, and its *benzylidene* derivative, m. p. 156°.

All β-monalkylanhydracetonebenzils corresponding with these a-compounds, but not included in the foregoing list, have been already described by Japp and Burton (*loc. cit.*).

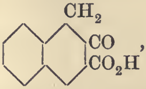
The oxidation products of the various methylanhydracetonebenzils are at present under investigation.

120. "Formation of carbazoles: a preliminary note." By F. R. Japp, F.R.S., and W. Maitland, B.Sc.

The fact that β-phenanthrol (*phenanthrone*),  $\begin{array}{l}C_6H_4\cdot CH\\ |\qquad\ \ \|\\ C_6H_4\cdot C\cdot OH\end{array}$, interacts, apparently in the keto-form,  $\begin{array}{l}C_6H_4\cdot CH_2\\ |\qquad\ \ |\\ C_6H_4\cdot CO\end{array}$, with phenylhydrazine, eliminating simultaneously water and ammonia, and yielding 2′:3′-diphenyleneindole (*phenyl-β-phenanthrylcarbazole*), , as in E. Fischer's synthesis of indoles (compare Japp and Findlay, *Trans.*, 1897, 71, 1117), led the authors to try whether β-naphthol, which β-phenanthrol in many respects resembles, would behave in an analogous manner. On heating β-naphthol with excess of phenylhydrazine there was no reaction, but on adding to the mixture some phenylhydrazine hydrochloride and continuing the heating, water and ammonia were evolved, and a fair yield of a *phenyl-β-naphthylcarbazole*,  $\begin{array}{l}C_6H_4\\ |\qquad >NH\\ C_{10}H_6\end{array}$ (needles melting at 134—135°), was obtained. The reaction does not take place when β-naphthol is heated with phenylhydrazine hydrochloride alone.

The following derivatives of this carbazole were prepared and analysed: *nitroso*-derivative, yellow flat needles, m. p. 144—145° (with decomposition); *acetyl* derivative, small pearly laminæ, m. p. 149°; *benzoyl* derivative, slender needles, m. p. 189·5°.

Two phenyl-β-naphthylcarbazoles—the number predicted by theory—are already known: one melting at 330°, isolated by Graebe and Knecht from coal-tar and afterwards synthesised by them by passing the vapour of phenyl-β-naphthylamine through a red-hot tube (*Annalen*, 1880, 202, 1); and a second obtained by Schöpff (*Ber.*, 1896, 29, 269) by elimination of carbon dioxide from phenyl-β-naphthylcarbazolecarboxylic acid, and asserted by him to melt at 120°. The melting points of the derivatives are given by Schöpff as follows: *nitroso*-derivative, 132°; *acetyl* derivative, 142°; *benzoyl* derivative, 170°. With the exception, however, of these very considerable differences in the melting points, the descriptions given by Schöpff of his compounds would apply to those prepared by the authors; moreover, various colour reactions which he mentions are the same in both cases. The authors, therefore, prepared Schöpff's phenyl-β-naphthylcarbazole by his method, and found that it melted at 134—135° (instead of at 120°, as stated by him) and was absolutely indistinguishable from their compound. As the yield by Schöpff's method is very poor, they did not trouble to prepare the derivatives over again from substances obtained in this way; but they have no doubt that similar errors in the determination of the melting points have been committed by the German investigator in the case of these also.

Schöpff obtained his phenyl-β-naphthylcarbazolecarboxylic acid by heating 3-hydroxy-β-naphthoic acid (m. p. 216°) with phenylhydrazine, a reaction which would correspond with that described by the authors, except that this so-called hydroxynaphthoic acid is the keto-form dihydro-2-keto-3-naphthoic acid, 

, and that the dition of phenylhydrazine hydrochloride is unnecessary.

α-Naphthol, when heated with the mixture of phenylhydrazine and its hydrochloride, yielded *phenyl-α-naphthylcarbazole* (m. p. 225·5°), already obtained by Kym (*Ber.*, 1890, **23**, 2465) by desulphurising thiophenyl-α-naphthylamine with finely divided copper. The present reaction does not take place so readily as with β-naphthol, and the yield is small.

The authors are engaged in extending this reaction to other phenols and to other arylhydrazines in presence of their hydrochlorides.

121. "Metal-ammonia compounds in aqueous solution. Part III. Solutions of salts of the alkaline earth metals." By H. M. Dawson and J. McCrae.

The distribution of ammonia between solutions of salts of the alkaline earth metals and chloroform has been determined at 20°, and the results obtained indicate that the calcium ions form complex ammonia ions to a slight extent in solution, whilst the strontium ion possesses the power of fixing ammonia in a less degree, and the barium ion has the lowest power.

122. "Metal-ammonia compounds in aqueous solution. Part IV. The influence of temperature on the dissociation of cupri-ammonia sulphate." By H. M. Dawson and J. McCrae.

The distribution of ammonia between water and chloroform and between aqueous copper sulphate and chloroform has been determined at 10° and 30°. The results indicate that the copper sulphate fixes more ammonia at the lower than at the higher temperature; but no exact quantitative statement can be made as to the influence of temperature on the dissociation of the compound $Cu4NH_3{\cdot}SO_4$, since within the limits of temperature at which the experiments were made this influence is very small.

The same relationship between ammonia concentration and distribution coefficient has been found at 10° and 30° as that previously observed at 20° (*Trans.*, 1901, **79**, 496).

123. "On the combined action of diastase and yeast on starch-granules." By G. H. Morris, Ph.D.

When yeast is allowed to act on a solution of starch-conversion products in the presence of active diastase, the quantity of matter fermented is greatly in excess of that which can be fermented by the yeast alone; and when active diastase and yeast are allowed to act conjointly on the so-called stable-dextrin, which under ordinary conditions is neither degradable by diastase nor fermentable by yeast it is entirely fermented.

It is now shown that a similar action takes place when certain ungelatinised starch-granules are submitted to the joint action of malt-extract and yeast, the quantity of starch decomposed by the joint action being about three times that dissolved by malt-extract alone. The increased action in the presence of yeast is not due to the removal of the soluble product, maltose, from the field of action, and the consequent greater activity of the diastase. No increased diastatic action takes place in the presence of yeast if the fermentative power of the latter is checked by chloroform, neither does any increase of action take place when the malt-extract is submitted to fermentation, and the yeast-cells removed, before the addition of the starch-granules.

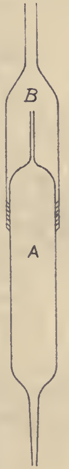
Precipitated diastase behaves in the same way as cold water malt-extract, but to a lesser extent.

The combined action of diastase and yeast only occurs with those starches which are attacked in the ungelatinised form by diastase, such as barley or malt starch. The granules of potato starch are not acted on by diastase even in the presence of yeast.

124. "A calibrating mercury pipette." By C. A. Bell, M.B.

The little device figured in the diagram will be found very useful in calibrations of all kinds. It is easily constructed on any scale; the volume of mercury delivered by it is for all practical purposes constant, and the time saved by its use is considerable.

The mercury reservoir, *A*, is made from a piece of soft German or soft Jena tubing, of moderate wall thickness and free from internal flaws. At the lower end it is drawn out to a narrow tube terminating in an orifice about 0·4 mm. in diameter. The edge of this orifice may be slightly fused, but not so as to invert it. At its upper end, *A* is drawn out to a very fine capillary tube, which should be of such diameter at its narrowest section that a pressure of *at least* 15 cm. of mercury is required to drive the metal through it. A short tube of such narrow bore is not easily prepared in an ordinary blow-pipe or Bunsen flame; the final drawing may, however, be easily effected in the outer mantle of a candle-flame, as in preparing a Lippmann's capillary electrometer. The little tube so formed should be cut at such a point that the diameter of the portion left on *A* (from 1 to 1·5 cm. in length) diminishes continuously from *A* to the end. A constantly increasing pressure is then required to drive mercury nearer and nearer to the orifice.



The reservoir *A* thus prepared is cemented, as shown, air-tight into a somewhat wider tube, *B*, which is drawn out at its upper end so that an india-rubber tube may be attached to it. The cement used may be sealing-wax; but if *B* is just wide enough to receive *A*, a much neater joint may be made with fused silver chloride. A little of the chloride is melted in a porcelain crucible and the well heated end of *B* dipped into it repeatedly until a sufficient quantity of the chloride has been collected. That which adheres to the inner surface of *B* is removed with a penknife; the previously warmed end of *A* is then passed into *B*, and the two tubes heated together high above a Bunsen flame, to avoid reduction of the silver, until the chloride melts. When prepared in this way, the pipette may be heated and dried by a current of air, if necessary, without disconnecting *A* and *B*.

To use the pipette, an india-rubber tube of some length is slipped over the narrow end of *B*, and secured air-tight by a few turns of soft copper wire, the ends of the wire being left loose. The point of the pipette is then plunged well below the surface of mercury contained in a bottle or basin, and suction applied until the metal rises to within a couple of millimetres of the capillary orifice. If the capillary tube has been properly formed, it can, without the slightest difficulty, be brought to any desired level which may be marked on the outside of *B*; but generally it is sufficient to bring it within a short distance of the orifice. A rather coarse capillary measured by a microscope micrometer was found to have, at the orifice, a diameter of 0·008 cm. The capacity of a tube of this diameter is only 0·00005 c.c. per centimetre of length, so that a variation in the level of a millimetre either way is of small importance.

The filling having been accomplished, the rubber tube is pinched; the pipette may then be lifted and carried about without the loss of a particle of mercury, so long as it is held in a nearly vertical position. Inclining it, however, by increasing the effective pressure on the capillary, may cause mercury to pass from *A* to *B*. This is much less likely to happen when in the process of filling the mercury has not been drawn right up to the orifice; the pressure may then increase or diminish considerably without causing the escape of mercury from either end of *A*.

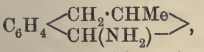
In discharging the pipette, the pressure of the fingers on the rubber tube having been released, the mercury is allowed to trickle gently down the side of the tube or vessel to be calibrated. Usually a short thread of metal remains in the lower prolongation of *A*; this is best removed by pinching the rubber tube near its open end with the fingers of the hand holding the pipette, and compressing it about its centre with the other hand. It is not advisable to blow into *B*, as in the course of a calibration moisture from the breath may find its way into *A*, causing the formation of air bubbles within it.

As air bubbles never form in *A* when the mercury entering it is dry and free from surface impurities, any sensible variation in the volume delivered at constant temperature can be due only to variations in the point at which disruption occurs in the mercury when the pipette is raised. These, however, are exceedingly small. In a series of tests with a pipette holding about 17 grams of mercury, and having an outflow orifice 0·05 cm. in diameter, the weight of mercury delivered was constant within 0·0005 gram, or in volume 0·00004 c.c. By making the outflow orifice very small, still greater constancy can be secured; but the time occupied in charging and emptying is then greatly increased. In conducting a test of this kind, of course, the temperature of the mercury must be carefully observed. Mercury contained in a bottle or jar can never be assumed to be at room temperature, and when poured into a basin its temperature may alter rapidly from a variety of causes.

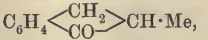
Sometimes a small globule of metal sticks very persistently in the lower constricted part of *A*. Such a globule can usually be rinsed out by sucking back a little of the metal already delivered, especially if the part of the tube containing it has been previously warmed.

The advantages of this pipette over Bunsen's well-known calibrating device are obvious. The quantity of mercury required for any calibration is a minimum; the metal need never be touched by the fingers; and as surface impurities are excluded by the pipette, which acts as a filter, the mercury delivered by it is always bright and clean, and lies in perfect contact with the wall of the receiving vessel.

125. "α-Amido-β-methylhydrindene." By F. S. Kipping and G. Clarke.



The authors have prepared α-amido-β-methylhydrindene, $C_6H_4{<}\genfrac{}{}{0pt}{}{CH_2\cdot CHMe}{CH(NH_2)—}{>}$, in order to study the salts obtained by combining it with various optically active acids, and thus perhaps to elucidate the curious behaviour of its lower homologue hydrindamine (Kipping, *Trans.*, 1900, **77**, 861; and Kipping and Hall, *Trans.*, 1901, **79**, 442).



β-Methylhydrindone, $C_6H_4{<}\genfrac{}{}{0pt}{}{CH_2}{CO}{>}CH\cdot Me$, is easily obtained by the action of aluminium chloride on α-methylhydrocinnamic chloride, ring formation taking place with the elimination of hydrogen chloride (compare Kipping, *Trans.*, 1894, **65**, 680; Kipping and Hill, *Trans.*, 1899, **75**, 144; and Kipping and Hunter, *Trans.*, 1901, **79**, 604).

This method gives much better results than the treatment of the acid with concentrated sulphuric acid (von Miller and Rhode, *Ber.*, 1890, **23**, 1888), the yield being from 70 to 80 per cent. of the theoretical.

β-Methyl-α-hydrindoxime crystallises in well-defined octahedra melting at about 103°. The base, of which the formula is given above, is obtained by reducing the oxime with sodium amalgam in dilute acetic acid solution. It resembles hydrindamine in general properties.

Since α-amido-β-methylhydrindene contains two asymmetric carbon groups, it should consist of four optically different forms, and when combined with optically inactive acids it might be expected to give rise to two series of salts.

As a matter of fact, on fractionally crystallising the *hydrochloride* of the original base from water, it is resolved into a sparingly soluble salt which forms long, silky needles decomposing at about 252°, and a readily soluble salt which is obtained in small, ill-defined nodular masses decomposing at about 225°.

The two hydrochlorides are probably the salts of the two externally compensated ($\genfrac{}{}{0pt}{}{+\,-}{+\,-}$ and $\genfrac{}{}{0pt}{}{+\,-}{-\,+}$) bases, but the more readily soluble one may not be quite free from its isomeride. The sparingly soluble salt gives a *platinichloride*, $(C_{10}H_{13}N)_2,H_2PtCl_6 + 2H_2O$, which crystallises from water in lustrous, yellow plates decomposing at about 192°, whilst the readily soluble isomeride gives a *platinichloride*, $(C_{10}H_{13}N)_2,H_2PtCl_6$, which is anhydrous, and decomposes at about 202°.

The *benzoyl* derivative prepared from the sparingly soluble hydrochloride crystallises in silky needles melting at 169°, whereas the corresponding compound, obtained from the readily soluble hydrochloride, melts at about 138°.

The *sulphate* of the original base crystallises in large transparent prisms, and does not seem to be resolved into different products when fractionally crystallised from water.

The investigation of these bases is being continued.

126. "Stereoisomeric α- and α'-sulphonic derivatives of camphor." By H. E. Armstrong and T. M. Lowry.

The authors have further examined Reychler's camphorsulphonic acid, prepared by sulphonating camphor by means of a mixture of sulphuric acid and acetic anhydride; they have also prepared corresponding acids from chloro- and bromo-camphor which are reducible to Reychler's acid. They confirm Reychler's observation that two camphorsulphonamides are formed by the action of ammonia on the sulphochloride, and show that this is not due to any want of homogeneity in the latter, but to the occurrence of isomeric change during the interaction.

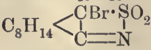
Reychler's camphorsulphonic acid is probably an α-acid, the sulpho-group occupying the same position as the bromine atom in α-bromocamphor. When the sulphochloride or sulphobromide is acted on with dilute ammonia the action proceeds normally, only the α-sulphonamide, m. p. 223°, being produced; the isomeric α'-sulphonamide, m. p. 132°, is formed when strong ammonia is used and the action is allowed to proceed violently; it is a labile substance, and is readily converted into the stable α-sulphonamide by the action of bromine or of mineral acids.

Camphor-α-sulphobromide, m. p. 93°, $[\alpha]_D +26°$. *Camphor-α-sulpho-p-bromoanilide*, m. p. 165°, $[\alpha]_D +56°$. *Camphorsulphopiperidide*, m. p. 140°, $[\alpha]_D +32{\cdot}2°$, is the chief product of the action of piperidine on the sulphochloride, but a more soluble *piperidide*, m. p. 55°, $[\alpha]_D +33{\cdot}6°$, is also produced.

α-Bromocamphor-α'-sulphonic acid is readily isolated in the form of the *calcium* salt, $(C_{10}H_{15}SO_4)_2Ca + 6H_2O$; this crystallises from hot water in pearly scales. The *sulphochloride*, m. p. 65°, $[\alpha]_D +104°$, yields a single *sulphonamide*, m. p. 156°, $[\alpha]_D +106°$, which is reduced by zinc dust and acetic acid to camphor-α'-sulphonamide. The *sulphoanilide*, m. p. 106°, $[\alpha]_D +177°$, is reduced to camphor-α-sulphoanilide. The

sulphopiperidide, m. p. 123°, $[\alpha]_D$ +111°, is reduced to the camphorsulphopiperidide melting at 140°.

α-Chlorocamphor-α′-sulphochloride has m. p. 60°, $[\alpha]_D$ +81°. The *sulphonamide*, m. p. 141°, $[\alpha]_D$ +83°, is reduced to camphor-α-sulphonamide.

When α-bromocamphor-α′-sulphonamide is boiled with acetic anhydride it is converted into an *anhydride*, $C_{10}H_{14}BrSO_2N$, m. p. 186°, $[\alpha]_D$ +98°, to which the formula  $C_8H_{14}<\begin{array}{l}\mathrm{CBr\cdot SO_2}\\ \;|\qquad\;\; |\\ \mathrm{C{=\!=}N}\end{array}$, may perhaps be assigned; it is reduced by zinc dust and acetic acid to camphor-α-sulphonamide. By the action of bromine on camphor-sulphonamide or of bromhydric acid on α-bromocamphor-α′-sulphonamide, the *stereoisomeric anhydride* of α′-bromocamphor-α-sulphonamide, m. p. 166°, $[\alpha]_D$ +41°, is also produced. By the further action of bromine these are converted into the *anhydride*, $C_{10}H_{13}Br_2SO_2N$, of a *dibromocamphorsulphonamide*, m. p. 195°, $[\alpha]_D$ −7°, which on reduction yields camphor-α-sulphonamide.

The *anhydride* of *α-chlorocamphor-α′-sulphonamide* m. p. 167°, $[\alpha]_D$ +60°, yields camphor-α-sulphonamide on reduction. An *anhydride*, $C_{10}H_{13}Cl_2SO_2N$, of a *dichlorocamphorsulphonamide* may be prepared by the action of chlorine on camphorsulphonamide, chlorocamphorsulphonamide, or its anhydride; m. p. 172°, $[\alpha]_D$ +4°, on reduction this yields camphor-α-sulphonamide.

127. "Displacement of alkyls from phenols by nitration. I. Thymol."

By A. T. Larter.

Maldotti, in a recent note (*Gazzetta*, 1900, 30, ii, 365), states that trinitrothymol is formed on nitrating dinitrothymol; he was unable to analyse the product, and bases his statement solely on molecular weight determinations made by the cryoscopic method. This conclusion is in opposition to the result arrived at by Armstrong and Rennie (*Chem. News*, 1883, 47, 115), who found that the so called trinitrothymol was in reality trinitrometacresol.

The author has repeated the experiments at Dr. Armstrong's request, and his results confirm the conclusion arrived at by Armstrong and Rennie.

The melting point of the product from thymol is the same as that of trinitrometacresol, and is unaffected when the substance is mixed with the trinitro-compound prepared from metacresol. On methylation, the product affords an ether identical with that prepared from trinitrometacresol, the two substances melting at 91°, whether singly or in admixture, and giving the same trinitrometatoluidine (m. p. 136°) when subjected to the action of ammonia.

When dinitrothymol ethyl ether is subjected to nitration, it is converted into trinitrometacresol ethyl ether—an observation of importance as proving that the displacement of the alkyl does not involve the formation at an intermediate stage of a keto-compound.

128. "Taka-diastase and reversed ferment action." By A. C. Hill.

The hydrolysis of dilute starch solutions by taka-diastase ends in an almost complete transformation to glucose, as shown by the combined polarimetric and copper reduction methods of estimation; no dextrin which resists further hydrolysis is formed, and there is sufficient maltase in commercial taka-diastase to convert all the maltose to glucose.

A solution containing 35 per cent. of glucose and 6 per cent. of maltose hydrate, that is, 41 per cent. of total sugar, on treatment by taka-diastase containing maltase, was further hydrolysed until the measurements indicated nearly 39 per cent. of glucose and about 2 per cent. of maltose hydrate. A 60 per cent. solution of glucose, however, similarly treated, showed a reversed ferment action until its optical and reducing properties corresponded with those of a solution containing 58 per cent. of glucose and 2 per cent. of maltose hydrate. On diluting the solution without boiling, hydrolysis again took place. The difference in equilibrium point in this case from that found by the author when acting on concentrated glucose solutions with yeast extract (*Trans.*, 1898, 73, 634) (in the latter case the measurements at equilibrium corresponded to a mixture of 34 per cent. of glucose and 6 per cent. of maltose hydrate) is probably to be explained by the presence in the yeast extract of enzymes other than maltase and diastase, whereby other polysaccharides are formed either from glucose or maltose, such ferment actions being quite distinct from a possible formation of higher polysaccharides from maltose, which may occur also in the case of taka-diastase.

LIBRARY.

The Library will be closed for stock-taking during the first fortnight of August. Fellows are particularly requested to return all Library books in their possession **not later than July 27th.**

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

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The following are abstracts of papers received during the vacation and published, or passed for publication, in the *Transactions* :

129. Additional notes on dinitro-orthoanisidine. A chemical reaction in which one of the products continues the same reaction. By R. Meldola and J. V. Eyre.

The authors give further evidence in support of the constitutional formula assigned to the dinitroanisidine already described (*Proc.*, 1901, **17**, 131). The 3 : 4 : 6-triaminoanisole and the corresponding 3 : 4-diamino-6-acetaminoanisole both form azines on condensation with benzil, which are described. The view put forward (*loc. cit.*), that the eliminated nitro-group comes out in the form of nitrous acid, is confirmed by quantitative determinations of the amount of diazo-oxide formed from known weights of dinitroanisidine in acetic acid solution with accurately titrated solutions of nitrite. The latter was added to the extent of one-fourth of the theoretical quantity required on the assumption that one molecule of dinitroanisidine requires one molecule of nitrite. In all cases the diazo-oxide produced, as determined by the quantity of azo-β-naphthol compound formed, was far in excess of that capable of being produced by the nitrite added, thus proving that the nitro-group eliminated by the nitrous acid continues the process of diazotisation.

130. "Ethyl sec-octyl tartrate and its dibenzoyl and diacetyl derivatives." By J. McCrae.

Diethyl tartrate and octyl alcohol when saturated in the cold with hydrochloric acid give ethyl octyl tartrate, which is purified by distillation and washing with water. By the action of excess of acid chloride on this mixed ester, the dibenzoyl and diacetyl derivatives have been prepared. The optical rotation of these compounds has been determined, and the author finds that the molecular rotations are similar to the constants for the corresponding diethyl tartrates. This is a confirmation of the rule suggested by Guye, namely, that when substitution is effected at a point sufficiently far removed from the asymmetric carbon atom, only a slight change in the rotation is produced.

131. "The esterification of 3-nitrophthalic acid." By A. McKenzie.

The esterification of 3-nitrophthalic acid does not proceed normally in accordance with V. Meyer's rule. The author has studied the action of amyl and methyl alcohols on 3-nitrophthalic acid and its anhydride, and shows that the isomeric α- and β-acid esters are formed on esterification, as well as the neutral ester in certain cases.

The compounds 2-*iso*amyl-3-nitrophthalic acid and *d*-2-amyl-3-nitrophthalic acid are also described.

132. "Derivatives of 3-nitrotolyl-4-hydrazine." By F. G. Pope and J. M. Hird.

The *hydrochloride* was prepared by Meyer and Lecco's method, and forms orange-red plates or needles, m. p. 190—191° with decomposition. The free base forms red tufts of needles, m. p. 110°. The *pyruvic acid hydrazone* forms yellow needles, m. p. 203° with decomposition. The *ethyl ester* of the pyruvic hydrazone is obtained as small, yellow needles, m. p. 140°. The *semicarbazide* forms small, yellow needles m. p. 201°, and gives a deep violet coloration with cold alcoholic potash. The following compounds have also been prepared: *salicylaldehyde hydrazone*, scarlet needles, m. p. 226°; *furfuraldehyde hydrazone*, red needles, m. p. 165—166°; *benzaldehyde hydrazone*, red needles, m. p. 166°; *phenylthiosemicarbazide*, tufts of golden-yellow needles, m. p. 188°; *allylthiosemicarbazide*, yellow needles, m. p. 168—170°; *acetylnitrotolyl hydrazine*, yellow needles, m. p. 161°.

133. "The constituents of the sandarac resins." By T. A. Henry, D.Sc.

The sandarac of commerce is the naturally exuded resin of various species of *Callitris*, usually either *C. quadrivalvis* or *C. verrucosa.*

Both varieties of resin consist of a mixture of resin acids and terpenes separable by steam distillation. From the latter, d-*pinene* has been isolated and identified. The chief volatile constituent is a diterpene, boiling at 265°, $\mu_D = 1{\cdot}5215$, $[\alpha]_D = +55°$, which behaves like a saturated substance, forming no additive compounds with bromine, hydrogen chloride, or nitrosyl chloride. Two resin acids have been isolated and examined. One of these has the composition $C_{20}H_{30}O_2$ (m. p. = 171°, b. p. 265°, 11 mm.), and closely resembles in behaviour the isomeric d-*pimaric acid* of Vesterberg (*Ber.*, 1885, **18**, 3331), but is optically inactive, and is therefore named *inactive pimaric acid.* On reduction with hydriodic acid, it gives a diterpene, $C_{20}H_{32}$. On oxidation with permanganate, pimaric acid yields acetic acid and a crystalline substance melting at 206°, which is probably *trimellitic acid.*

The second resin of sandarac has not been obtained in a crystalline form, but the highly deliquescent sodium salt and the characteristic lactone have been prepared; from analyses of these, the formula of the free acid is probably $C_{30}H_{48}O_5$. For this substance, the name *callitrolic acid* has been retained. The acid is remarkably resistant to the action of reagents, being unattacked even by hot fuming nitric acid. When heated in a vacuum, it is decomposed with the formation of carbon dioxide and a diterpene identical with that occurring naturally in the resin.

134. "Condensation of phenols with esters of the acetylene series Part VI." By S. Ruhemann and E. Wragg, B.A.

The authors have continued the research on the interaction of phenols with ethyl chlorofumarate and ethyl phenylpropiolate, using eugenol and *m*-xylenol. From the former phenol they obtained *ethyl eugenoxyfumarate* and the corresponding acid, from which they have not been able to prepare the pyrone-compound in a pure state. *m*-Xylenol reacts with ethyl chlorofumarate to form *ethyl* m-*xylenoxyfumarate*, the acid of which, on treatment with concentrated sulphuric acid, yields 6 : 8-*dimethyl*-1 : 4-*benzopyrone-2-carboxylic acid* (m. p. 210° with decomposition). This, on heating, loses carbon dioxide, giving 6 : 8-*dimethyl*-1 : 4-*benzopyrone* (m. p. 80—81°). With ethyl phenylpropiolate, *m*-xylenol forms *ethyl β*-m-*xylenoxycinnamate*, which is hydrolysed by alcoholic potash to the acid. This yields, on heating, m-*xylenoxystyrene,* and is decomposed by sulphuric acid into carbon dioxide, acetophenone, and *m*-xylenol.

The authors have attempted to ascertain whether only the phenyl group in the aryl ethers of the unsaturated hydroxy-acid prevents the condensation to the pyrone compound taking place, and have found that *β-phenoxycrotonic acid*, $CH_3{\cdot}C(O{\cdot}C_6H_5){\vdots}CH{\cdot}CO_2H$, on heating, loses carbon dioxide and yields *β-phenoxypropylene*, $CH_3{\cdot}C(O{\cdot}C_6H_5){\vdots}CH_2$ (b. p. 170°), and with sulphuric acid it breaks up into carbon dioxide, acetone, and phenol. To determine whether the condensation to the 1:4-benzopyrone compound depends upon the configuration of the aryl ethers of the hydroxy-acid, the authors have treated ethyl *β-iso*chlorocrotonate instead of its stereoisomeride with sodium phenolate; they find, however, that the same substance is formed as when ethyl *β*-chlorocrotonate is used.

135. "The hydrobromides of undecylenic acid." By J. Walker and J. S. Lumsden.

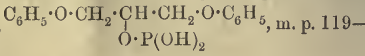
When hydrobromic acid is added to undecylenic acid, a bromo-undecylic acid, m. p. 51°, is formed at the same time as Brunner's acid, m. p. 35°. It is shown that the former is ω-bromo-undecylic acid, $CH_2Br{\cdot}(CH_2)_9{\cdot}CO_2H$, and not Brunner's acid as was previously supposed.

136. "Normal decane-dicarboxylic acid." By J. Walker and J. S. Lumsden.

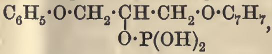
This acid was prepared by electrosynthesis from pimelic acid and was found to be identical with an acid prepared from ω-bromo-undecylic acid. The solubility in water differs entirely from the solubility of the acids described by Nördlinger and Komppa.

137. "Action of the chlorides of phosphorus on certain aromatic ethers of glycerine." By D. R. Boyd.

The author has studied the behaviour of symmetrical diphenyl glycerol-ether and some similar compounds when treated with the pentachloride and trichloride of phosphorus respectively.

Phosphorus pentachloride with diphenyl-glycerol-ether yields *β*-chlorotrimethylene-glycol-diphenyl-ether, $C_6H_5{\cdot}O{\cdot}CH_2{\cdot}CHCl{\cdot}CH_2{\cdot}O{\cdot}C_6H_5$, m. p. 37°. Phosphorus trichloride and diphenyl-glycerol-ether give a product which, on treatment with water, yields glyceryl-diphenyl-ether-phosphorous acid,  $C_6H_5{\cdot}O{\cdot}CH_2{\cdot}\underset{O\cdot P(OH)_2}{\underset{|}{C}}H{\cdot}CH_2{\cdot}O{\cdot}C_6H_5$, m. p. 119—120°.

Phenyl-*p*-tolyl-glycerol-ether, $C_6H_5\cdot O\cdot CH_2\cdot CH(OH)\cdot CH_2\cdot O\cdot C_7H_7$, m. p. 73·5—76°, which is obtained by the action of phenyl-glycide ether on *p*-cresol, yields *β*-chloro-trimethylene-glycol-phenyl-*p*-tolyl ether, $C_6H_5\cdot O\cdot CH_2\cdot CHCl\cdot CH_2\cdot O\cdot C_7H_7$, m. p. 60°, and glycerol-phenyl-*p*-tolyl-ether phosphorous acid,



$$C_6H_5\cdot O\cdot CH_2\cdot \underset{O\cdot P(OH)_2}{\underset{|}{C}}H\cdot CH_2\cdot O\cdot C_7H_7$$

, m. p. 106—107°.

Further, di-*p*-tolyl-glycerol-ether yields *β*-chloro-trimethylene-glycol-di-*p*-tolyl ether, $C_7H_7\cdot O\cdot CH_2\cdot CHCl\cdot CH_2\cdot O\cdot C_7H_7$, m. p. 70°, and glyceryl-di-*p*-tolyl-ether-phosphorous acid, m. p. 111—112°.

138. "The autofermentation and liquefaction of pressed yeast."

By A. Harden and S. Rowland.

The time required for the liquefaction of pressed yeast is greatly diminished by rise of temperature, whilst the rate of evolution of carbon dioxide is greatly increased. The evolution of gas ceases as soon as the yeast becomes liquid and hence is small at 50°, owing to the rapid liquefaction of the mass (1—1½ hours), whilst the total volumes evolved at 39° and 26° do not differ greatly although the times required for liquefaction are 5 and 53 hours respectively. At 14° the time required is 16 days, the rate of evolution being extremely slow, and the total volume evolved about 75 per cent. of that produced at 26°. Alcohol is produced simultaneously, the process being apparently a true alcoholic fermentation of the glycogen of the cell. Microscopic examination shows that as the evolution of gas proceeds the glycogen disappears and the vacuole of the cell increases in size. Finally, the vacuolar contents are discharged and the cell appears shrunken and irregular in outline, whilst the protoplasmic contents are highly granular.

In the presence of oxygen, a process of oxidation accompanies the evolution of carbon dioxide, a considerable rise of temperature being produced and the total volume of carbon dioxide increased. When exposed to a continuous current of oxygen, a sample of yeast was found to lose 26 per cent. of its carbon.

139. "Non-existence of the so-called suboxide of phosphorus. Part II."

By C. H. Burgess and D. L. Chapman.

Substances obtained according to the methods described by Michaelis and Pitsch (*Ann.*, 1899, **310**, 45) and Michaelis and v. Arend (*Ann.*, 1901, **314**, 259) have been prepared and analysed, and shown to contain such a large amount of hydrogen that they cannot be regarded as a suboxide, but as red phosphorus containing hydrogen compounds.

The authors show that some of the analytical results of Michaelis and Pitsch indicate that the substances prepared by them contained water, and that the proof of the absence of hydrogen in the substance, described by them as a pure suboxide, is inconclusive.

As red phosphorus is easily soluble in aqueous alcoholic potash, with formation of a red solution, red phosphorus resembles in this respect the so-called sub-oxide.

The authors conclude that both the properties and the analytical results support the view that the substances hitherto described as sub-oxides of phosphorus are only impure forms of amorphous phosphorus.

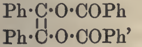
140. "The action of ammonia on metals at high temperatures." By G. T. Beilby and G. G. Henderson.

Platinum, gold, silver, copper, iron, nickel and cobalt have been exposed to the action of ammonia at temperatures ranging from 400° to 900°. In every case the physical effect of the treatment was to disintegrate the metal completely, whilst a large proportion of the ammonia was resolved into its elements. The fracture of metals which have been exposed to this action is spongy or cellular ; under the microscope the metal appears as if it had been suddenly cooled whilst in a state of active effervescence. The penetration of the ammonia molecules into the metal is remarkably quick if the conditions are favourable.

The authors believe that the physical effects which result from the action of ammonia upon metals at high temperatures are due to the alternate formation and dissociation of nitrides taking place between certain narrow limits of temperature, the reaction going in one direction or the other according as ammonia or hydrogen molecules preponderate in the gases which are in contact with the molecules of the metal at and below the surface. In several cases the formation of nitrides has been definitely proved. The absorption of small quantities of nitrogen by pure iron renders it hard and brittle like steel.

141. "The condensation of benzil with dibenzyl ketone." By G. G. Henderson and R. H. Corstorphine, B.Sc.

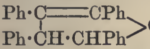
Benzil and dibenzyl ketone readily condense when warmed with excess of aqueous potash, and *tetraphenyl*cyclo*pentenolone* is produced. It melts at 208°, is readily soluble in benzene but only sparingly so in alcohol. It yields an *oxime*, m. p. 167°, which when heated in alcoholic solution with *p*-bromophenylhydrazine gives a crystalline *hydrazone* melting at 169°. The *acetyl* derivative melts at 218°. Tetraphenyl*cyclo*pentenolone quickly reduces potassium permanganate, does not combine with bromine, but is slowly converted into a very unstable *bromine* derivative. When cautiously oxidised in the cold with chromic anhydride dissolved in glacial acetic acid, tetraphenyl*cyclo*pentenolone gives benzoic acid and a neutral *compound*, $C_{28}H_{20}O_4$, possibly *iso*benzil,



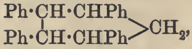
$\begin{array}{l}\text{Ph·C·O·COPh}\\ \quad\|\\ \text{Ph·C·O·COPh}\end{array}$, colourless crystals, m. p. 164—165°.

Tetraphenyl*cyclo*pentenolone undergoes partial reduction when boiled for an hour or two under a reflux condenser with hydriodic acid and red phosphorus, but the product is not tetraphenyl*cyclo*pentenone, but a *tetraphenyl*cyclo*pentenol,* which crystallises in colourless needles, m. p. 162°, is readily soluble in benzene, very sparingly so in alcohol ; it quickly decolorises potassium permanganate in alkaline solution. It does not react either with hydroxylamine or with phenylhydrazine, but gives an *acetyl* derivative, colourless tablets, m. p. 181°. Bromine converts it into a *bromine* derivative, $C_{29}H_{22}BrOH$, colourless needles, m. p. 215°. By treatment with phosphorus pentachloride or alcoholic hydrogen chloride it yields a *mono-chlorotetraphenyl*cyclo*pentene,* $C_{29}H_{23}Cl$, colourless prisms, m. p. 181°.

When heated at 180° in a sealed tube with hydriodic acid and red phosphorus, tetraphenyl*cyclo*pentenol is reduced to two hydrocarbons, $C_{29}H_{24}$ and $C_{29}H_{26}$, which can be separated by means of ether, in which the former is easily and the latter somewhat sparingly soluble. From its mode of formation the former is no doubt 1:2:4:5-*tetraphenyl*cyclo*pentene,*



$\begin{array}{l}\text{Ph·C}{=\!=}\text{CPh}\\ \quad|\\ \text{Ph·CH·CHPh}\end{array}\!\!>\!CH_2$. The other hydrocarbon is obtained in colourless crystals from alcohol. It melts at 80·5—81°, and is apparently identical with the 1:2:4:5-tetraphenyl*cyclo*pentane,



$\begin{array}{l}\text{Ph·CH·CHPh}\\ \quad|\\ \text{Ph·CH·CHPh}\end{array}\!\!>\!CH_2$, already prepared by Wislicenus in a different manner. The former melts with decomposition at over 300°, and the latter at 80·5—81°.

142. "The chlorodibromo- and dichlorobromo-benzenes." By W. H. Hurtley, D.Sc.

Twelve tri-substituted chlorobromobenzenes should exist according to theory. The two symmetric compounds have been obtained by Hantzsch, Schleissing, and Jäger (*Ber.*, 1897, **30**, 2334), the 1-chloro-3:5-dibromobenzene from 3:5-dibromoaniline. The author has prepared all the twelve compounds from anilines of known constitution, many of which have not previously been obtained. The asymmetric compounds were prepared from dihalogen anilines, by replacing the amino-group by chlorine or bromine by Gattermann's method (*Ber.*, 1890, **23**, 1222), and by eliminating the amino-group from asymmetric trihalogen anilines. The symmetric compounds resulted from the symmetric trihalogen anilines by eliminating the amino-group. The vicinal compounds were obtained from vicinal trihalogen anilines, also by eliminating the amino-group.

All the trichlorobromobenzenes are solids: the vicinal crystallise in well defined rhombic plates; the symmetric, in long slender prisms; and the asymmetric, in short thin prisms. All are very soluble in benzene, ether, chloroform, and petroleum, but less so in alcohol, from which they can be readily crystallised. The vicinal and symmetric compounds are easily volatile in steam, whilst the asymmetric are much less so.

Asymmetric; 1:2-*dichloro-4-bromobenzene*, prisms, m.p. 24·5°, b.p. 237°; 1:3-*dichloro-4-bromobenzene*, prisms, m. p. 25°, b. p. 235°; 1:4-*dichloro-2-bromobenzene*, prisms, m. p. 33°, b. p. 235°; 1-*chloro*-3:4-*dibromobenzene*, prisms, m. p. 35·5°, b. p. 256°; 1-*chloro*-2:4-*dibromobenzene*, prisms, m. p. 27°, b. p. 258°; 1-*chloro*-2:-5-*dibromobenzene*, prisms, m. p. 40·5°, b. p. 259°.

Symmetric; 1:3-*dichloro-5-bromobenzene*, slender prisms, m. p. 77·5°, b. p. 232°; 1-*chloro*-3:5-*dibromobenzene*, slender prisms, m. p. 99·5°, b. p. 256°.

Vicinal; 1:2-*dichloro-3-bromobenzene*, rhombic plates, m.p. 60°, b. p. 243°; 1:3-*dichloro-2-bromobenzene*, rhombic plates, m. p. 65°, b. p. 242°; 1-*chloro*-2:6-*dibromobenzene*, rhombic plates, m. p. 69·5°, b. p. 265°; 1-*chloro*-2:3-*dibromobenzene*, rhombic plates, m. p. 73·5°, b. p. 264°.

The following new anilines and anilides were also obtained:—3:6-*dichloro-4-bromoaniline*, needles, m. p. 91° and its *acetyl* derivative, prisms, m. p. 189°; 2:3-*dichloro-4-bromoaniline*, needles, m. p. 77·5°, and its *acetyl* derivative, prisms, m. p. 138·5°; 2:4-*dichloro-5-bromoaniline*, flattened prisms, m. p. 86°, and its *acetyl* derivative, prisms, m. p. 192°; 2:4-*dichloro-3-bromoaniline*, plates, m. p. 78°, and its *acetyl* derivative, prisms, m. p. 138°; 3:5-*dichloro-4-bromoaniline*, needles, m. p. 129°, and its *acetyl* derivative, short prisms, m. p. 220°; 3-*chloro*-4:6-*dibromoacetanilide*, prisms, m. p. 174°; 3-*chloro*-2:4-*dibromoaniline*, plates, m. p. 88°, and its *acetyl* derivative, prisms, m. p. 152°; 2-*chloro*-4:5-*dibromoaniline*, flattened needles, m. p. 93°, and its *acetyl* derivative, needles, m. p. 193°; 2-*chloro*-3:4-*dibromoaniline*, plates, m. p. 91°, and its *acetyl* derivative, needles, m. p. 146°.

October 31st, 1901. Extra Meeting. Professor EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

Dr. ARMSTRONG delivered the Frankland Memorial Lecture.

Frankland was born at Churchtown, Lancashire, in January, 1825. When about seven years old he went with his mother and stepfather to Lancaster, where he lived until he entered Playfair's laboratory in 1840; he there attended a private school kept by a Mr. Willasey, until he was twelve years old, when he entered the Lancaster Grammar School in the lowest class, leaving it at the age of fifteen from the highest. His mother appears to have had a great influence in developing his scientific tastes, leading him as a child to pay attention to surrounding objects; these lessons were the means of causing him to seek information about natural phenomena for himself in books. Before he was twelve, he had read many books on chemistry, electricity, and magnetism, among others, Priestley's Researches on electricity. He thus learnt how to make a Volta's pile, with which he decomposed water; and having obtained a magnet, made most of the experiments of which he had read. His master appears to have encouraged him—for on hearing that he was showing experiments to his school-fellows, he invited him to bring his apparatus into the class room and demonstrate to the school. When about twelve years old he had a strong inclination for a mechanical trade, and having access to a cabinet-maker's workshop, acquired no slight skill. Mr. Willasey, however, dissuaded him, and awakened his ambition by telling him that he ought to aim at becoming a doctor: but as his parents were led to suppose that to give him a medical training was beyond their means, on leaving school he was apprenticed to a druggist in Lancaster. The six years he spent in this capacity were years of the hardest labour. His master not only never attempted to teach him anything, but did his best to hinder his scientific advance. But Frankland's ardour was not to be damped: by rising at four, he managed to get one hour and a half for botanical work before the day's toil began. During the three years he was at the Lancaster Grammar School, he was able to carry on chemical experiments in a laboratory fitted up in the house of a school friend; and as an apprentice he enjoyed the friendship of two men—Mr. Christopher Johnson, M.R.C.S., and Dr. James Johnson, who advised him what to read and lent him apparatus, the latter even fitting up a laboratory in which Frankland and other druggists' apprentices in the town spent their evenings, Mr. Johnson occasionally telling them of Dalton's work, which was then going on.

It was on Mr. Johnson's advice that Frankland entered Playfair's laboratory in 1845. Playfair had then just been appointed organic chemist to the Government Department of Woods and Forests, of which the Geological Survey was a branch. Before six months had passed, Playfair made him his assistant at the College for Engineers, Putney; later on, early in 1847, he became Playfair's chief assistant. Meanwhile he had been offered the post of Professor of Chemistry in the Royal Agricultural College, Cirencester, and had decided to accept the office; but a difficulty arising, and acting on the advice of Kolbe, then one of Playfair's assistants, he decided instead to go to Germany. Kolbe and he went together to Marburg in May, 1847. In the autumn he returned to England to take up the position of lecturer on botany, chemistry, and geology at Queenwood College, Hants. There he met Tyndall, and so great was the ardour of the two young men that they rose at four and taught each other until eight o'clock before doing their work in the school. He returned to Germany again to work with Bunsen in October, 1848, Tyndall, who at that time thought of becoming a chemist, accompanying him. He took the degree of Ph.D. in June, 1849, and shortly afterwards became engaged to Fräulein Fick, whom he married in 1851. In August, 1849, he went to Giessen to work in Liebig's laboratory. At Christmas he left for Berlin, intending to work with Rose, but receiving there the offer of the chair vacated by Playfair at the Putney College, he returned home. He remained at Putney until January, 1851, when he became Professor of Chemistry at Owens College, Manchester. In October, 1857, he returned to London as lecturer on chemistry in St. Bartholomew's Hospital. In 1863, he resigned this post to become Professor of Chemistry in the Royal Institution. In 1865, he succeeded Hofmann at the Royal College of Chemistry and Royal School of Mines, a post which he held until he retired in 1885. Meanwhile, in 1868, he had been appointed a member of the Rivers Pollution Commission. He died on August 9, 1899.

Frankland began research work with Kolbe very few months after entering Playfair's laboratory: before they left for Germany—within eighteen months of his having commenced to study chemistry systematically—they had completed their work on the hydrolysis of the nitriles, which led to the determination of the constitution of the great group of acids now known as carboxylic acids. They had begun to study the action of potassium on ethyl cyanide with a view to isolating ethyl; this work was completed in Marburg, and Frankland made his maiden appearance as reader of a paper before the Chemical Society in communicating the results which Kolbe and he had obtained. As soon as he was installed at Queenwood, he began independent work and sought to isolate the alcohol radicles. On continuing this research, on the occasion of his second visit to Bunsen's laboratory, he soon succeeded in preparing "ethyl" and "methyl," and in the course of these experiments made the all important discovery of zinc methyl and ethyl. The amyl compounds were studied in Liebig's laboratory. At Putney he continued his work on organo-metallic compounds; and it was here that he studied the action of chlorine on stannethyl, &c., and was first led to discover the law of valency; this work was completed at Manchester: the memoir in which Frankland formulated the doctrine which must hereafter always be associated with his name was read to the Royal Society on June 17, 1852.

Besides giving an account of Frankland's early education and subsequent career and considering his character, Dr. Armstrong entered somewhat fully into an analysis of the work he did with Kolbe; he then proceeded to consider his investigations relating to the isolation of the hydrocarbon radicles and his researches on the organometallic compounds, which culminated in the discovery of the doctrine of valency, leaving the vast mass of work—chemical and physical—which he did subsequently to be dealt with in the printed memoir. Attention was called to the great importance of Frankland and Kolbe's work on the acids of the acetic series. The two papers in which their results are described were referred to as deserving to rank as classics, as specimens of highly original and clearly reasoned precise argument, as well as on account of the importance of the results they disclosed. That they were in no way appreciated at the time of publication was due to the extraordinary hold which Gerhardt's type-system had obtained. For a like reason, Frankland's statement of the doctrine of valency produced originally but a slight impression, and it was only at a later stage—owing to the use that Kekulé had made of it in discussing the constitution of carbon compounds, benzene especially—that its importance became recognised, and it became the guiding principle: and even then Frankland's services were to a great extent overlooked. It was beyond the power of his contemporaries, in fact, to appreciate the bearings of his discoveries when they were first made known: and when the wave of Gerhardtism had spent its force, they appeared almost commonplace, so great had been the advance in knowledge meanwhile and so insensibly had Frankland's ideas crept into their minds. Reasons were fully stated which appear to justify the belief that Kekulé must have derived his inspiration from Frankland, who alone is to be regarded as the discoverer of the doctrine of valency—Kekulé's great work having been to develop the consequences of its application to carbon compounds.

Taking the whole of Frankland's work into account, it constitutes a record which is altogether remarkable as evidence of his originality, of the catholic character of his interests, of his practical ability and of his vigour: it must serve to place him in the very highest rank among the chemists of the century, whilst his early work entitles him to be regarded as one of the great pioneers in establishing the modern doctrine of constitution.

On the motion of Professor Odling, seconded by Sir H. E. Roscoe, a vote of thanks was passed to Dr. Armstrong for his lecture.

November 7th, 1901. Professor McLeod, F.R.S., Vice-President, in the Chair.

Messrs. W. Lowson, E. Neumann, A. Findlay, E. Horton, G. Tatam, G. W. F. Holroyd, and S. E. Sheppard were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Frederick Thomas Allen, 15, Sea View Terrace, Hartlepool; Arthur Baker, 130, Walmersley Road, Bury, Lancashire; Walter Craven Ball, 19, Lewisham Hill, S.E.; Andrew Russell Bennet, 1, Wildman Street, Nottingham; Harding Bickford, 46, Currie Street, Adelaide, S. Australia; Henry Boyers, 20, Knox's Street, Sligo; William Burton, Cotleigh, Nunnery Fields, Canterbury; William Cormack, 3, Westfield Place, Eskbank, Midlothian; Frank Crossley, Duchy Bank, Seedley Road, Pendleton, Manchester; John Howard Davidson, Golden Hill, Stoke-on-Trent; Francis Davis, Whitwell, Elland, Yorks; Robert English, 8, Colwall Villas, Burley Road, Beckenham, Kent; Eugène Arthur Fasnacht, Clayton Mount, Newton Heath, Manchester; Henry Wippell Gadd, 42, Union Road, Exeter; Hermann Charles Thomas Gardner, London Hospital, E.; Edward Gillman, Barbados, West Indies; William Peer Groves, Oldfield Hall, Altrincham, Manchester; Herbert Harding, 20, Stratford Road, Kensington, W.; Beresford Ingram, 19, Lewisham Hill, Lewisham, S.E.; Walter Henry Jollyman, Spartan House, Colney Hatch Lane, Muswell Hill, N.; James David Kettle, 1, Vardens Road, St. John's Hill, S.W.; Julian Bruce Kingsmill, Ordnance College, Woolwich; Alfred Tabois Larter, 184, Holland Park Avenue, W.; Peter Macdonald, Lapstone Road, Millom, Cumberland; Lewis Jenkin Meyrick, 137, City Road, Birmingham; Charles Killick Millard, The Gilroes, Groby Road, Leicester; Albert Edward Parkes, 43, Whitehorse Street, Stepney, E.; Charles James Tomlin Pollitt, Athole, Church Street, Croydon, Sydney, N.S.W.; Charles Leonard Royle, Nellikuppam, South Arcot, India; John Henry Ryffel, 10, Onslow Gardens, Highgate, N.; George Charlton Scott, Eston Grange, Grangetown, R.S.O., Yorks; Edward Charles Sherwood, 39, Vincent Square, Westminster, S.W.; Norman Smith, 15, King Street, Bury; William Henry Templeman, 67, Park Street, Spring Bank, Hull; Harold Fay Fleetwood Varley, 22, Strathblaine Road, New Wandsworth, S.W.; Herbert George Wallace, Axim, West Africa; Philip Lewington Whitehouse, 32, Lawrence Street, Dowanhill, Glasgow.

Of the following papers, those marked * were read:

*143. "Note on the supposed formation of an oxide of hydrogen higher than the dioxide" By W. Ramsay, F.R.S.

Bach (*Ber.*, 1900, **33**, 1506) has stated that evidence can be obtained of the existence of a peroxide of hydrogen higher than the dioxide by comparing the amount of oxygen evolved from peroxide on treatment with permanganate with the weight of the peroxide present in solution, as determined by titration with permanganate. It was suggested by Armstrong (*Proc.*, 1900, **16**, 154) that the discrepancy should be attributed to the formation of persulphuric acid and Caro's acid, due to the action of the peroxide on the sulphuric acid present during the titration. The author now showed that if peroxide be added to a mixture of sulphuric acid with permanganate, all the oxygen is evolved, but that if the permanganate be added to a mixture of peroxide with sulphuric acid, only a partial evolution of oxygen takes place, for neither persulphuric acid nor Caro's acid is readily attacked by permanganate. On the other hand, if acetic acid be substituted for sulphuric acid, the amount of oxygen evolved corresponds exactly with the amount of permanganate added, whether the latter be added to a mixture of peroxide and acetic acid, or whether the peroxide be added to a mixture of permanganate and acetic acid.

*144. "The electrolytic reduction of nitrourea." By G. W. F. Holroyd.

Nitrourea can be reduced to semicarbazide much more easily if the reduction be effected by electrolysis than by the original method of Thiele and Heuser (*Ann.*, 1895, **288**, 311).

An aqueous solution of ammonium chloride serves as electrolyte. No porous cell is used. The reduction is effected at 20°. The poles are of iron or zinc. In the latter case, an alternating current is employed to prevent the formation of a bridge of zinc from pole to pole. Four ampere hours are required for the reduction of each gram of nitrourea. The semicarbazide is precipitated as benzalsemicarbazone. The yield of recrystallised benzalsemicarbazone is 60 per cent. of the theoretical.

*145. "The constitution of pilocarpine. Part III." By H. A. D. Jowett, D.Sc.

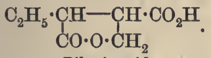
On a fuller examination of the products of the oxidation of *iso*pilocarpine with permanganate, it was found that, in addition to acetic and pilopic acids, small quantities of *propionic acid* and of a new acid named *homopilopic acid*, $C_8H_{12}O_4$, are formed. The formula $C_7H_{10}O_4$, previously proposed for pilopic acid, is confirmed both by analyses of various derivatives of the acid and by the determination of the molecular weight of the methyl ester.

Pilopic acid, $C_7H_{10}O_4$, melts at 104° (corr.) and is dextrorotatory $[\alpha]_D^{15°} = +36{\cdot}1°$ in aqueous solution, with excess of alkali present $[\alpha]_D^{17°} = +3{\cdot}2°$. Its *methyl ester* boils at 155—160° under 10 mm. pressure, and at 275° under 757 mm. Its *barium* salt, $(C_7H_9O_4)_2Ba$, is a microcrystalline powder readily soluble in water. The *anilide*, $C_7H_9O_3NHPh$, forms white, flat, pearly plates melting at 110°. The *acid strychnine* salt, $C_{21}H_{22}O_2N_2,(C_7H_{10}O_4)_2$, is readily soluble in water and alcohol, sparingly soluble in ether, and melts at 120°. The *diamide* of the *hydroxy-acid*, $C_7H_{14}O_3N_2$, formed by the action of ammonia on ethyl pilopate, occurs in acicular crystals, sparingly soluble in cold water or alcohol, freely soluble in these solvents when hot, and melts at 160°. The *barium* salt of the *hydroxy-acid*, $C_7H_{10}O_5Ba,H_2O$, is a microcrystalline powder freely soluble in water, $[\alpha]_D^{15°} = +6{\cdot}1°$. *Homopilopic acid*, $C_8H_{12}O_4$, boils at 235—237° under 20 mm. pressure, and is dextrorotatory, $[\alpha]_D^{21°} = +45{\cdot}4°$, with excess of alkali $[\alpha]_D^{21°} = +5{\cdot}9°$. Titration of the acid showed it to be a monobasic lactonic acid. Its *ethyl ester* boils at 210° under 10 mm. pressure. The *barium* salt, $(C_8H_{11}O_4)_2Ba$, is very hygroscopic. The *diamide* of the *hydroxy-acid*, $C_8H_{16}O_3N_2$, forms well-defined prisms melting at 208°, fairly soluble in hot water, but sparingly soluble in cold or hot alcohol or cold water. The *barium* salt of the *hydroxy-acid*, $C_8H_{12}O_5Ba,H_2O$, is a microcrystalline powder stable in the air. The author showed that the piluvic acid of Pinner and Kohlhammer (*Ber.*, 1901, **34**, 727) may possibly be a mixture of homopilopic with some pilopic acid. Repetition of previous experiments on the bromination of ethyl pilopate, giving rise to the formation of *iso*butyric acid, show that this acid is the product of a secondary reaction, and that the formula previously proposed (*Trans.*, 1900, 77, 851) must be abandoned. Pilopic acid is not easily reduced by hydriodic acid, as no change occurs on heating to 210°.

Pilopic acid, when fused with potassium hydroxide at a high temperature, yields only one product—normal butyric acid. Fusion at a lower temperature produces a small quantity of a crystalline, isomeric, unsaturated acid melting at 190°, but the greater part of the acid is recovered unchanged.

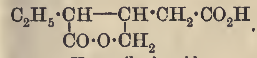
Homopilopic acid on fusion with potash at a medium temperature yields α-ethyltricarballylic acid, $C_8H_{12}O_6$.

From a consideration of the results obtained, the following formulæ are proposed for pilopic and homopilopic acids :



$$\begin{array}{l} C_2H_5\cdot CH—CH\cdot CO_2H. \\ \qquad\ \ | \qquad\quad\ | \\ \qquad CO\cdot O\cdot CH_2 \end{array}$$

Pilopic acid.



$$\begin{array}{l} C_2H_5\cdot CH—CH\cdot CH_2\cdot CO_2H. \\ \qquad\ \ | \qquad\quad\ | \\ \qquad CO\cdot O\cdot CH_2 \end{array}$$

Homopilopic acid.

*146. "A new synthesis of α-ethyltricarballylic acid." By H. A. D. Jowett, D.Sc.

α-Ethyltricarballylic acid has been synthesised by the following reactions :—

(1) *Ethyl β-ethylcyanosuccinate* was prepared by condensing the sodium compound of ethyl cyanacetate with ethyl α-bromobutyrate (compare Bone and Sprankling, *Trans.*, 1899, **75**, 839).

(2) The sodium compound of ethyl β-ethylcyanosuccinate was condensed with ethyl bromoacetate with formation of ethyl α-ethyl-β-cyanotricarballylate. This reaction may be represented by the equation

$$CH_2BrCO_2Et + CO_2Et\cdot C(CN)Na\cdot CH(C_2H_5)\cdot CO_2Et = \\ CO_2Et\cdot CH_2\cdot C(CN)(CO_2Et)\cdot CH(C_2H_5)\cdot CO_2Et + NaBr.$$

(3) *Ethyl ethylcyanotricarballylate* was hydrolysed with sulphuric acid; the resulting acid, heated at 180°, gave α-ethyltricarballylic acid.

Ethyl β-ethylcyanosuccinate, $CO_2Et\cdot C(CN)H\cdot CH(C_2H_5)(CO_2Et)$, boils at 167—168° under 20 mm. pressure, and has a density of 1·0647 at 15°/15°.

Ethyl α-ethyl-β-cyanotricarballylate,

$$CO_2Et\cdot C(C_2H_5)H\cdot C(CN)(CO_2Et)\cdot CH_2\cdot CO_2Et,$$

boils at 208° under 21 mm. pressure, and has a density of 1·0972 at 16°/16°.

α-Ethyltricarballylic acid, $CO_2H\cdot C(C_2H_5)H\cdot CH(CO_2H)\cdot CH_2\cdot CO_2H$, melts at 157°, the figure previously given by Michael (*Ber.*, 1900, **33**, 3745). The following new derivatives have been prepared :—The *anhydro-acid*, $C_8H_{10}O_5$, could only be obtained amorphous, and yields an amorphous compound with aniline; the *triethyl ester* is a colourless, limpid liquid boiling at 170—175°. The *barium* salt, $(C_8H_9O_6)_2Ba_3,7H_2O$, is crystalline, and is more soluble in cold than in hot water. Only 6 molecules of water of crystallisation are lost at 180°. The *calcium* salt, $(C_8H_9O_6)_2Ca_3,9H_2O$, is characteristic, as its aqueous solution, on heating to 100°, becomes a firm jelly which liquefies on cooling. The *copper* salt, $(C_8H_9O_6)_2Cu_3,5H_2O$, is a greenish-blue powder.

*147. "The benzoylation of fatty acids in the presence of ammonia; formation of amides." By K. J. P. Orton.

On treating many monobasic fatty acids with excess of benzoyl chloride in the presence of ammonia and sodium hydroxide, the amides of the acids are formed together with benzamide. When methylamine is substituted for ammonia, methylamides are obtained. If the fatty acid and benzoyl chloride are heated together at 100—120° for 2 or 3 hours before treating with ammonia (or methylamine) and sodium hydroxide, the yield of amide is much increased and amounts in some cases to as much as 75 per cent. of the acid used. When the acids possess hydroxyl or amino-groups, they are at the same time both benzoylated and converted into amides.

The following amides have been prepared by this method: Phenylacetamide; *p*-nitrophenylacetamide; p-*nitrophenylacetmethylamide*, $C_6H_4NO_2\cdot CH_2\cdot CONHMe$, crystallises in long, silky, colourless needles (from water) m. p. 159°; p-*benzaminophenylacetamide*, $C_6H_5\cdot CO\cdot NH\cdot C_6H_4\cdot CH_2\cdot CONH_2$, prepared from *p*-aminophenylacetic acid, crystallises from alcohol in small plates, m. p. 248°; p-*benzaminophenylacetic acid*, $C_6H_5\cdot CO\cdot NH\cdot C_6H_4\cdot CH_2\cdot CO_2H$, prepared by the Schotten-Baumann method, forms tufts of needles, m. p. 205—206°; p-*benzoxyphenylacetamide*, $C_6H_5\cdot CO\cdot O\cdot C_6H_4\cdot CH_2\cdot CONH_2$, prepared from *p*-hydroxyphenylacetic acid, forms insoluble, microscopic crystals, m. p. 167—169°; *benzoylmandelic amide*, $C_6H_5\cdot CH(O\cdot CO\cdot C_6H_5)\cdot CONH_2$, prepared from mandelic acid, crystallises from water in tufts of silky needles, m. p. 162°; and *benzoylmandelic methylamide* in needles, m. p. 139°; *cinnamic methylamide*, $C_6H_5\cdot CH{:}CH\cdot CONHMe$, crystallises from water in plates, m. p. 111°; *dibromocinnamic methylamide* crystallises in lustrous prisms, which become coloured above 200°, melt and decompose at 214°. *Dibenzoyltyrosinamide*,

$$C_6H_5\cdot CO\cdot O\cdot C_6H_4\cdot CH_2\cdot CH(NH\cdot CO\cdot C_6H_5)\cdot CONH_2,$$

prepared from tyrosin, crystallises in aggregates of lustrous needles, m. p. 246°. Stearic amide is obtained from stearic acid.

It is probable that either a compound anhydride of benzoic and the fatty acid (or possibly a simple anhydride of the fatty acid) is first formed; with ammonia (or methylamine) the anhydride yields the amide of the fatty acid.

*148. "Liquid nitrogen peroxide as a solvent." By P. F. Frankland, Ph.D., F.R.S., and R. C. Farmer, M.Sc., Ph.D.

A study of the properties of this liquid led to the following results. Inorganic salts are not dissolved by nitrogen peroxide, and in most cases are unattacked. The liquid is a powerful solvent for organic compounds. It is a moderately inert reagent, but its activity is greatly increased by the presence of traces of water or of lower oxides. Most organic acids, as well as halogen and nitro-compounds and quinones, could be dissolved unchanged and recovered by evaporation. Hydroxy-compounds were generally, though not always, attacked, phenol being converted to 2 : 4-dinitrophenol. Aniline derivatives were diazotised and some compounds were merely oxidised, as anthracene, which was completely converted into anthraquinone.

The electric conductivity of hydrochloric acid, as well as of a number of organic acids, was examined in this solvent and found to be too small to be measured, showing that the liquid does not bring about electrolytic dissociation. A number of molecular weight determinations of dissolved substances were made by the ebullioscopic method. The constant for 1 gram-molecule in 100 grams of solvent was first determined by a series of experiments in which indifferent compounds (nitrobenzene, &c.) were used and found to be equal to 13·7. On extending the experiments to organic acids, these were found in many cases to be associated to double molecules. This was found to hold for acetic and benzoic acids and for several of their derivatives. Di- and tri-nitrophenol, on the other hand, gave their normal molecular weights.

*149. "On an incrustation from the Stone Gallery of St. Paul's Cathedral." By E. G. Clayton, F.I.C.

Around what is known as the Stone Gallery, at the base of the dome of St. Paul's Cathedral, is a balustrade of Portland stone, surmounted by a heavy coping-stone of the same material. Much of the surface of the stone is greatly "weathered," and is coated by a stratum of a grey or black substance, which in some places (especially on the under-side of the coping-stone) attains a thickness of three-quarters of an inch. This material, which is brittle and detachable with a knife, has a very rough and irregular surface, is stalagmitic in character, and, though differing in colour, in other respects resembles very closely some boiler deposits. It can easily be reduced to a fine, grey powder, which, under the microscope, shows no morphological features indicating the presence of fungoid or similar matter.

Some of this incrustation has been analysed, with the following results.

In 100 parts by weight:

Water, lost at 100°	2·06
„ „ 150°	22·48
Organic matter (carbon)	1·10
Lime	26·44
Magnesia	0·27
Ferrous oxide	1·31
Silica, sand, &c.	10·39
(Including combined silicic acid, SiO_2, 2·33)	
Sulphuric acid (combined)	34·93
Phosphoric acid „	1·02
Carbonic „	none
Chlorine	trace
	100·00

Bases and radicles being combined, the composition is apparently as follows:

Water (100°)	2·06
„ (150°)	22·48
Carbon (soot)	1·10
Calcium sulphate	59·38
„ phosphate	2·22
„ silicate	1·63
Magnesium silicate	0·67
Iron silicate	2·40
Sand and uncombined silica	8·06
	100·00

Evidently, therefore, the substance is composed chiefly of calcium sulphate, hydrated, together with some siliceous matter. Calcium carbonate, which might have been expected to be present, is not one of the constituents. What, then, is the origin of the incrustation? In the immediate vicinity, there is no obvious source of gypsum or plaster. It cannot have been blown upwards from the bare leaden roof of the Cathedral or floor of the gallery. The stones of the balustrade are cemented, of course, with mortar. Still less likely is it that so much calcium sulphate has found its way from the neighbouring thoroughfares. The sand and soot may, to a great extent, be thus derived, and perhaps a small proportion of the calcium sulphate represents coal-ash transported by wind. But after a careful consideration of all the circumstances, and especially the characteristic appearance of the incrustation, it is suggested that the presence of the main component is principally due to two centuries' solvent and weathering action of rain, charged with sulphurous and sulphuric acids derived from the gases and smoke of innumerable surrounding chimneys. The action exerted by rain beating heavily against the stone, in that exposed situation, must be very considerable. The deposit of calcium sulphate, left by the water dripping and running from the under-side of the coping-stone, has become gradually thicker, just as is the case with stalagmite and calcareous tufa, to which the external features of the incrustation give it a curiously close resemblance. That the weathering influence of rain has been potent, no one examining the surface of the Portland stone can have a moment's doubt.

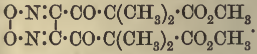
150. "Note on asbestos." By E. G. Clayton, F.I.C.

The following analyses of four kinds of asbestos (one of which, A, was stated to be of English origin, the remainder being examples of the ordinary mineral) are recorded for information and comparison, no published analysis of asbestos of English origin having been observed by the writer in any scientific journal.

Including the English specimen, all possess the general composition distinctive of true amphibole-asbestos, rather than asbestiform serpentine or chrysotile, which contains much more water and little or no lime. The English mineral consisted of moderately long, greyish-green fibres, easily separable, and in appearance resembling Italian asbestos, though characterised by unusual brittleness. B, C, and D, which had been pulverised before reaching the writer, were apparently associated with a little gypsum :

	A.	B.	C.	D.
Water lost at 100°	1·19	0·87	0·86	—
,, ,, 150°	0·05	0·13	0·00	—
,, ,, a red heat	0·70	0·95	1·83	—
Total water	1·94	1·95	2·69	1·39
Silica (with traces of manganese oxide, alkalis, &c.)	60·88	48·48	59·82	61·74
Lime	11·11	6·19	5·91	6·91
Magnesia	10·84	35·52	28·27	25·72
Alumina	trace	4·69	1·25	2·30
Iron oxide	15·23			
Sulphuric anhydride	—	3·17	2·06	1·94
	100·00	100·00	100·00	100·00

151. "The action of nitric acid on methyl dimethylacetoacetate. Preliminary notice." By W. H. Perkin, Ph.D., F.R.S.

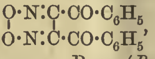
When methyl dimethylacetoacetate is heated with nitric acid of sp. gr. 1·4—1·45, vigorous action sets in, and if, when this has subsided, the product is thrown into water, a yellow oil separates which on standing becomes semi-solid owing to the deposition of crystals. The crystalline product, when collected and purified by crystallisation from alcohol, melts at 65° and gives numbers on analysis agreeing with those required for the formula $C_{14}H_{18}O_8N_2$. This new substance is decomposed by alkalis with formation of dimethylmalonic acid, *iso*butyric acid, hydrogen cyanide, carbon dioxide, and ammonia, and when treated with ammonia gives dimethylmalonamide. Its composition appears to be expressed by the formula  $\begin{matrix} O\cdot N{:}C\cdot CO\cdot C(CH_3)_2\cdot CO_2CH_3 \\ | \quad\quad | \\ O\cdot N{:}C\cdot CO\cdot C(CH_3)_2\cdot CO_2CH_3 \end{matrix}$.

It reacts with semicarbazide, yielding a crystalline substance of the composition $C_{16}H_{24}O_8N_8$.

When the substance melting at 65° is reduced with tin and hydrochloric acid, it yields two colourless substances melting at about 154° and 173°, as well as a third substance which melts at 177° and crystallises in primrose-yellow needles.

The two colourless substances are isomeric and have the composition $C_{14}H_{20}O_8N_2$; the one melting at 154° gives a crystalline condensation product on treatment with semicarbazide, whereas the other, melting at 173°, does not.

The primrose-yellow substance (m. p. 177°) has the formula $C_{13}H_{16}O_5N_2$, and is much less soluble in alcohol than the colourless reduction products. It combines with semicarbazide and with phenylhydrazine. It dissolves in potassium hydroxide, forming an intense orange-red solution from which a colourless, crystalline acid, $C_{12}H_{14}O_5N_2$, separates on adding a mineral acid. This acid melts at 214°, yields a well characterised barium salt, $(C_{12}H_{13}O_5N_2)_2Ba$, and is reconverted by treatment with methyl alcohol and hydrochloric acid into the primrose-yellow substance, which is therefore its methyl ester. The constitution of the three reduction products will be considered in the detailed paper.

Substances similar in constitution to that obtained by the action of nitric acid on methyl dimethylacetoacetate have already been prepared in the aromatic series, thus Hollemann (*Ber.*, 1895, **28**, 3360) obtained diphenyldinitrosacyl,  $\begin{matrix} O\cdot N{:}C\cdot CO\cdot C_6H_5 \\ | \quad\quad | \\ O\cdot N{:}C\cdot CO\cdot C_6H_5 \end{matrix}$, by the action of concentrated nitric acid on acetophenone. Baum (*Ber.*, 1895, **28**, 3211) also obtained a condensation product of similar constitution by treating acetylmesitylene with nitric acid.

152. "Note on the displacement of benzyl by methyl in substituted nitrogen compounds." By H. O. Jones, B.A., B.Sc.

In trying to effect the union of methyl iodide and dibenzylaniline, it was found that no action took place in the cold, but that on heating the mixture to 100° in a sealed tube only phenyltrimethylammonium iodide, unchanged dibenzylaniline and benzyl iodide were obtained (*Proc. Camb. Phil. Soc.*, 11, [ii], 114). On heating together dibenzylaniline and methyl iodide in the proportion of one molecule of the former to three of the latter to 100° for about two hours, a nearly theoretical yield of phenyltrimethylammonium iodide was obtained, the two benzyl groups having been eliminated as benzyl iodide.

It was of interest, in view of the fact that V. Meyer (*Ber.*, 1875, 8, 936) had shown that methyl iodide had no action on tetraethylammonium iodide, to see whether methyl iodide would displace the benzyl radicle in an ammonium compound. Phenylmethyldibenzylammonium iodide was therefore heated to 100° with methyl iodide, with the result that it was entirely converted into phenyltrimethylammonium iodide and benzyl iodide. The same displacement was effected in phenyldimethylammonium iodide and benzylaniline.

Experiments were made with ethyl, propyl, isobutyl, and allyl iodides on the above benzyl compounds; and with methyl iodide on other phenyl ammonium compounds; but at 100° no displacement was observed in any case.

The ready displacement of the benzyl radicle by methyl may be due to the "mobility" of the former, which is usually split off to some slight extent as iodide when a benzyl ammonium iodide is heated either in the dry state, or in aqueous or alcoholic solution, combined with the stability of phenyltrimethylammonium iodide, which is only decomposed at 220—225°. However, the non-displacement of benzyl by alkyl radicles other than methyl, and of such radicles as ethyl and propyl by methyl, suggests some peculiar relation (possibly stereochemical) existing only between the methyl and benzyl radicles.

ADDITIONS TO THE LIBRARY.

I. Donations.

Berthelot, M. Les Carbures d'hydrogène 1851—1891. Recherches expérimentales. 3 vols. T. i. L'acétylène: synthèse totales des carbures d'hydrogène. T. ii. Les carbures pyrogénès, series diverses. T. iii. Combinaison des carbures d'hydrogène avec l'hydrogène, l'oxygène, les éléments de l'eau. Paris. 1901. From the Author.

Idris, T. Howell Williams. Notes on essential oils, with special reference to their use, composition, chemistry, and analysis. With tables of constants of the more commonly occurring oils. Second edition. London. 1901. From the Author.

Phipson, Thomas Lamb. Researches on the past and present history of the earth's atmosphere, including the latest discoveries and their practical applications. London. 1901. From the Author.

Fischer, Emil, and Guth, Max. Der Neubau des Ersten Chemischen Instituts der Universität Berlin. Ill. Berlin. 1901. From Prof. Fischer.

At the next meeting, on Thursday, November 21st, the following papers will be communicated:—

"On the oxidation of sulphurous acid to dithionic acid by metallic oxides." By H. C. H. Carpenter.

"Optically active β-hydroxybutyric acids." By A. McKenzie.

"On the hydrochloride of thiocarbamide." By H. P. Stevens.

"The constituents of the essential oil of *Asarum Canadense*." By F. B. Power and F. H. Lees.

"Note on the reduction of trinitrobenzene and trinitrotoluene with hydrogen sulphide." By J. B. Cohen and H. D. Dakin.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 242.

November 21st, 1901. Professor Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

Messrs. R. Lloyd Whiteley and H. A. Tozer were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Walter Geoffrey Black, 9, Routh Road, Wandsworth Common, S.W.; Harry Burrows, The Green, Southgate, N.; Frederick Edward Catchpole, 11, Jerningham Road, New Cross, S.E.; James Ward Daniels, Westwood, Medomsley R.S.O., Co. Durham; Frederick Davis, "Stanley," Whalley, nr. Blackburn, Lancs.; Charles Dorée, 87, Gore Road, London, N.E.; Clarence J. Green, B.Sc., 24, Dalberg Road, Brixton Church, S.W.; Ernest Bowman Ludlam, University College, Bristol; Sydney Glyde Stephen Panisset, 7, Jersey Road, Strood, Rochester; William Charles Ross, 27, Pitt Street, Edinburgh; Francis Bernard Stead, Clifton College, Bristol; Arthur James Webb, 21, Hammelton Road, Bromley, Kent; Charles Edward Womersley, Kilpin Hill, nr. Dewsbury, Yorks.; and of Messrs. T. K. Gajjar, Gingaum, Bombay; J. S. Jameson, Durban, Natal; Albert William Denis Leahy, Darjeeling, India; and Walter Herbert Pay, Durban, Natal, authorised by the Council under Bye Law I (3).

EXTRAORDINARY GENERAL MEETING.

The President announced that he had received a requisition to summon an Extraordinary General Meeting at which it will be proposed:

(1) To change that part of Bye Law XI which now reads,

> "The Ordinary Scientific Meetings of the Society shall be held twice in every month, from November to June inclusive, except in the month of January, when the Society shall meet once only and also at Easter when, if the Council see fit, there shall be only one meeting in the month; the specific days and hours of meeting to be determined by the Council."

by deleting the words "the Council" and inserting in their place the words "an Extraordinary General Meeting."

(2) That the Ordinary Meetings of the Society shall continue to take place, as heretofore, on Thursdays, at 8 p.m.

Acting under the provisions of Bye Law XIII, he therefore summoned an Extraordinary Meeting for Thursday, December 12th, at 8 p.m.

The following is the text of the above-mentioned requisition:—

To the President of the Chemical Society.

Sir,

We, the undersigned Fellows of the Chemical Society, respectfully request you to summon an Extraordinary General Meeting of the Society, at the earliest possible date, for the purpose of:

(1) Proposing a modification of Bye Law XI, and
(2) Submitting a resolution.

We subjoin the terms of the proposed modification and resolution, and have the honour to remain,

Yours very faithfully,

Richard Berncastle.
R. L. Jenks.
George Harker.
T. Martin Lowry.
Walter C. C. Pakes.
Charles Mills.
H. Droop Richmond.
S. J. Peachey.
W. A. Wayland.
Alfred Wm. Harvey.
H. F. Fermor.
Arthur H. Coote.

Otto Hehner.
T. H. Page.
Edwin C. Jee.
Ernest Goulding.
Thomas A. Henry.
Geo. S. Blake.
F. B. Power.
H. A. D. Jowett.
Gerald T. Moody.
William A. Davis.
Geo. Bousfield.
Edward Horton.

Henry R. Redman.
James Moir.
Wm. J. Kemp.
G. S. Newth.
G. T. Morgan.
J. C. Philip.
Chapman Jones.
A. J. Bullen Cooper.
William Robertson.
Chas. A. West.
W. H. Merrett.
H. C. H. Carpenter
E. O. Courtman.
F. Stanley Kipping.
H. H. Robins.
W. R. Hodgkinson.
Bernard Dyer.
Edgar S. Barralet.
Samuel Rideal
T. A. Lawson.
R. J. Friswell.
J. W. Hinchley.
C. E. Browne.
F. F. Renwick.
Albert Cooper.
B. V. Storr.
P. Gerald Sanford.
H. R. Le Sueur.
Alfred C. Chapman.
Chas. E. Beadnell.
Edgar Neumann.
H. Bailey.
Francis H. Carr.
E. Haynes Jeffers.
T. FitzGibbon.
J. Wilson.
W. T. Gilles.
Alex. Guthrie.
W. P. Dreaper.
Arthur Lapworth.
D. Northall-Laurie.
J. T. Hewitt.
F. Dixon.
A. G. Bloxam.
Edgar M. Chapman.
K. J. P. Orton.
Godfrey Melland.
T. Slater Price.
Harry Silvester.
Thomas H. Pope.
Thomas Royle.
D. A. Sutherland.
D. A. Louis.
Henry P. Stevens.
Frederic Jas. M. Page.
S. Godfrey Hall.
Bertram Blount.
Charles Watson.
Chas. E. Eastick.
Peter MacEwan.
J. Lewkowitsch.
John Heron
Charles A. Kohn.
Walter T. Reid.
Oscar Guttmann.
S. Dickson.
James H. Millar.
Sidney Williamson.
Otto Rosenheim.
Philip Schidrowitz.
J. Vargas Eyre.
F. Southerden.
W. A. Lethbridge.
G. G. Quinn.
W. T. B. Ridge.
Leonard P. Wilson.
H. Wulff Kinnersley.
W. A. Handcock.
Arthur Marshall.
William Rintoul.
John Charles Burnham.
Sidney S. Napper.
Wm. T. Thomson.
Edward W. Lewis.
W. B. Woodbridge.
B. S. Bull.
G. Cecil Jones.
Arthur E. Ekins
E. H. Fisher.
Julian L. Baker.
Jas. Grant.
John Allan.
W. C. Reynolds.
W. H. Taylor.
H. C. Sayer.
E. F. Harrison.
John E. Mackenzie.
J. F. Thorpe.
Ju. Hübner.
L. G. Radcliffe.
Thos. R. Duggan.
Wm. Chattaway.
Martin Priest.
(name illegible).

It is proposed :—

(1) On line 7 of Bye Law XI (page 21, fifth line from top) to delete the words "the Council" and insert in their place the words "an Extraordinary General Meeting of the Society."

(2) To resolve that the Ordinary Meetings of the Society shall continue to take place, as heretofore, on Thursdays, at 8 p.m.

Of the following papers, those marked * were read:

*153. "On the hydrochloride of thiocarbamide." By H. P. Stevens.

The hydrochloride of thiocarbamide, CSN_2H_4,HCl, may be obtained directly by dissolving thiocarbamide in an excess of warm concentrated hydrochloric acid. On cooling, the salt separates out in large compact crystals, which have a strongly acid reaction, melting, with decomposition, below 100°, and are readily soluble in water and alcohol. They react with the latter solvent when warmed to form, probably, in the first case, ethyl chloride which, combining directly with thiocarbamide, yields the hydrochloride of ethyl-pseudo-thiocarbamide in white prisms.

The method of Glutz for the preparation of thiocarbamide hydrochloride yields a very impure product, due partly to loss of hydrochloric acid on concentration and partly to the salt reacting with alcohol during recrystallisation.

*154. "The constituents of the essential oil of Asarum Canadense."
By F. B. Power and F. H. Lees.

In a previous investigation of this oil by one of the authors (Power, *Inaug. Diss. Strassburg*, 1880; *Proc. Amer. Pharm. Assoc.*, 1880, **28**, 464) it was found to contain a terpene, $C_{10}H_{16}$; two fragrant alcohols, b. p. 196—199° and 222—226°, both having the composition $C_{10}H_{18}O$; a nearly inodorous body, b. p. 254—257°, which, on oxidation with chromic acid, afforded a crystalline acid, $C_9H_{10}O_4$, the latter having since been shown to be veratric acid by Petersen (*Ber.*, 1888, **21**, 1062), who has also identified the substance affording it as methyleugenol; a deep blue oil collected at 275—350°; a large amount of acetic acid combined with the alcohols of the oil in the form of esters, and a very small amount of a less soluble oily acid which was believed to contain valeric acid.

The present investigation has shown the oil to have a much more complex composition than was at first supposed. The authors have now identified the following compounds, most of them by well-defined crystalline derivatives. (1) A phenol, $C_9H_{12}O_2$, having a creosote-like odour; (2) pinene (nitrosochloride, m. p. 103—104°, and nitrolpiperidine, m. p. 118—119°); (3) *d*-linalool (citral and citryl-β-naphthocinchoninic acid, m. p. 195—198°); (4) *l*-borneol (camphor, m. p. 175°, $\alpha]_D = -40{\cdot}3°$, and oxime, m. p. 115—116°); (5) *l*-terpineol (a keto-lactone, $C_{10}H_{16}O_3$, m. p. 62—63°; terebic acid, $C_7H_{10}O_4$, m. p. 173—174°; and dipentene dihydriodide, $C_{10}H_{18}I_2$, m. p. 80°); (6) geraniol (diphenylurethane, m. p. 81—82°, and citral); (7) methyleugenol (bromomethyleugenol dibromide, $C_6H_2Br(OCH_3)_2 \cdot C_3H_5Br_2$, m. p. 78—79°; it is also shown that methyl*iso*eugenol does not exist in the oil); (8) a blue oil, boiling above 260°, and consisting of oxygenated compounds of undetermined composition but of alcoholic nature; (9) a lactone, $C_{14}H_{20}O_2$, having a very aromatic odour, but present in the oil in very small amount; (10) palmitic acid; (11) acetic acid; (12) a mixture of fatty acids, $C_6H_{12}O_2$ to $C_{12}H_{24}O_2$. The acetic acid is contained in the oil in the form of esters, whilst the higher fatty acids are in a free state.

A quantitative determination of the principal constituents was made. The amount of methyleugenol, determined by Zeisel's method, was found to be 36·9 per cent. The amount of esters, calculated as $C_{10}H_{17} \cdot C_2H_3O_2$, is 27·5 per cent.; the free alcohols, $C_{10}H_{18}O$, 13·3 per cent. The amount of pinene obtained by direct fractionation of the oil was about 2 per cent., and the amount of high boiling constituents, such as the blue oil, is therefore about 20 per cent.

DISCUSSION.

The PRESIDENT inquired as to the difference between *Asarum* and *Serpentaria*, the *A. Canadense* being known as Canada snake-root, whereas serpentaria was called Virginia snake-root.

Mr. DAVIS pointed out that Kremers had recently shown (*Pharm. Review*, 1901, **19**, 200) that the dark colour of the oil of wild bergamot (*Monarda fistulosa*) is due to small quantities of thymoquinhydrone formed by oxidation from thymoquinol, and asked whether the dark blue colour of the higher boiling point fractions of the oil obtained by the authors might not be caused by the presence of a quinhydrone.

Dr. POWER replied that although both *Asarum* and *Serpentaria* belong to the *Aristolochiaceæ*, they are very different, as are also the essential oils obtained from them. The oil from *A. Europæum* differs from that from *A. Canadense* in that the former contains the crystalline substance asarone, but apparently none of the alcohols or esters which are present in the latter. With regard to the colour of the oil, the chemical change noted by Kremers in oil of monarda would account for the red or brown colour of certain oils, but the colour of the blue oils must be attributed to substances of a totally different character.

155. "On the oxidation of sulphurous acid to dithionic acid by metallic oxides." By H. C. H. Carpenter.

Only two metallic oxides have hitherto been found to react with sulphurous acid so as to produce dithionic acid. These oxides are manganese dioxide and hydrated ferric oxide.

The object of the present research was the investigation of reactions which lead to the formation of dithionic acid, particular care being taken as to the purity of the sulphurous acid and the various oxides used. Dithionic acid is obtained when sulphurous acid reacts with (*a*) hydrated ferric oxide, $Fe_2O_3,3H_2O$, entirely freed from manganese; (*b*) hydrated manganic oxide, Mn_2O_3,H_2O, and (*c*) hydrated cobaltic oxide, $Co_2O_3.3H_2O$, but not with hydrated nickelic oxide, $Ni_2O_3,3H_2O$.

With hydrated ferric oxide, an almost theoretical yield of dithionic acid is obtained. Although it has not been found possible to obtain the theoretical yield of this acid from the corresponding hydrated oxides of manganese, cobalt, or nickel, yet there is very strong reason for believing, on account of the greater development of energy in the reduction of these oxides, that a partial or even complete decomposition of dithionic acid into sulphuric and sulphurous acids would take place. The facts which point to this conclusion are contained in the two following tables. The first shows the percentages of dithionic and sulphuric acids obtained from the four hydrated oxides already mentioned; the second indicates the changes of energy, expressed in thermal units, involved in the reduction of the oxides.

I.

Hydrated Oxides.	Percentage dithionate.	Percentage sulphate.
Ferric	96·06; 96·23	Not estimated
Manganic	75·52; 74·53	25·42
Cobaltic............	36·97; 35·07	63·80; 63·33
Nickelic.....	Nil	101·04

II.

Reduction of the hydrated oxides.	Heat of reaction.
$Fe_2(OH)_6 = 2Fe(OH)_2 + O + H_2O$............	− 546 K
$Mn_2(OH)_6 = 2Mn(OH)_2 + O + H_2O$............	− 448 K
$Co_2(OH)_6 = 2Co(OH)_2 + O + H_2O$.....	− 225 K
$Ni_2(OH)_6 = 2Ni(OH)_2 + O + H_2O$............	+ 13 K

A comparison of the two tables shows that the greater the energy required for the reduction of the hydrated oxides, the larger is the percentage yield of dithionic acid. The maximum yield is obtained with ferric hydrate, where the energy that needs to be supplied is such that it is possible to stop the reaction almost wholly at the stage represented by the equation (i), $Fe_2(OH)_6 + 3SO_2 = FeS_2O_6 + FeSO_3 + 3H_2O$.

Whether the slight deficit from the theoretical number is due to a slight decomposition of the nature (ii), $FeS_2O_6 = FeSO_4 + SO_2$, or to a defect in the method of estimation used, is a question which it has not been found possible to decide.

In the case of manganic oxide, about one-quarter, and in the case of cobaltic oxide, about two-thirds, of the dithionic acid formed is decomposed in the manner indicated in equation (ii).

The reduction of nickelic oxide differs essentially from that of the other three in being an exothermic change, and the energy liberated is such that the reaction cannot be stopped at the intermediate stage, but proceeds wholly to the last stage, and the only oxidation product is sulphuric acid.

The author has confirmed the results of Gay-Lussac and Welter, who showed that no dithionic acid was obtained by the reduction of the peroxides of lead and barium with sulphurous acid. In view of the negative character of these results, the action of sulphurous acid on the dithionates of these metals was studied. It was found that solutions of barium dithionate are quite unaltered, except at a temperature at which the influence of heat alone begins to be seen, when a gradual decomposition into barium sulphate and sulphur dioxide sets in. On the other hand, solutions of lead dithionate are decomposed instantaneously, even at 5°, lead sulphite being precipitated and free dithionic acid remaining dissolved.

156. "Optically active β-hydroxybutyric acids. Preliminary note." By A. McKenzie.

For certain work the author has been desirous of obtaining *d*- and *l*-β-hydroxybutyric acids. That a substance so simply constituted as externally compensated β-hydroxybutyric acid has not before this been resolved into its optically active components is due to the fact that the salts formed by neutralisation with the common alkaloids are readily soluble and crystallise with some difficulty. The author has resolved the inactive acid, which was prepared by the reduction of acetoacetic ester by sodium amalgam, by means of quinine with water as solvent. After systematic crystallisation, the neutral *l*-acid-*l*-quinine salt was isolated. This salt, which crystallises well, contains $4\frac{1}{2}H_2O$, is very easily soluble in cold ethyl alcohol, moderately so in chloroform, sparingly so in benzene, acetone, carbon tetrachloride, and in ether, and easily in boiling ethyl acetate. An alcoholic solution of the air-dried salt had the rotation $[\alpha]_D^{15°} = -129{\cdot}9°$ ($c = 2{\cdot}814$). The anhydrous salt melted at 124·5—125·5°. The *l*-acid from the quinine salt gave $[\alpha]_D^{16°} = -24{\cdot}9°$ ($c = 8{\cdot}3304$), whilst the sodium salt prepared from it gave $[\alpha]_D^{15°} = -14{\cdot}5°$ ($c = 8{\cdot}518$). These values for the specific rotations of the acid and its sodium salt agree with the values of Magnus-Levy, who obtained the *l*-acid from diabetic urine (*Archiv. für experim. Path. und Pharmak.*, 1901, **45**, 389).

The author prepared some *l*-acid from diabetic urine by the method of Magnus-Levy and converted it into quinine salt. The product, when deprived of its water of crystallisation, melted at 124·5—125·5°; an alcoholic solution of the air-dried salt gave $[\alpha]_D^{15°} = -129{\cdot}0°$ ($c = 2{\cdot}8052$).

Experiments are in progress with the object of isolating the *d*-acid by means of strychnine, the *d*-acid-*l*-strychnine salt being more insoluble in water than the *l*-acid-*l*-strychnine salt.

157. "Note on the reduction of trinitrobenzene and trinitrotoluene with hydrogen sulphide." By J. B. Cohen and H. D. Dakin.

By the reduction of 1 : 3 : 5-trinitrobenzene and 2 : 4 : 6-trinitrotoluene in alcoholic solution with hydrogen sulphide in presence of a trace of ammonia, the corresponding dinitrohydroxylamine compounds are formed, $C_6H_3(NO_2)_3 + 2H_2O = C_6H_3(NO_2)_2NHOH + H_2O$. *Dinitrophenylhydroxylamine* is an orange, crystalline substance, m. p. 114—116°, soluble in alcohol, benzene, and in hot dilute hydrochloric acid; *dinitrotolylhydroxylamine* crystallises from benzene in yellow rhombohedral crystals and from dilute hydrochloric acid in needles, m. p. 143—145°. Both compounds reduce alcoholic silver nitrate and Fehling's solution; they are slowly decomposed on boiling with dilute, more rapidly with concentrated hydrochloric acid, yielding the amido-compounds and losing oxygen, $C_6H_3(NO_2)_2NHOH = C_6H_3(NO_2)_2NH_2 + O$. In the case of trinitrotoluene, the nitro-group in the ortho-position undergoes reduction, a curious fact, seeing that ammonium sulphide effects the reduction of the para-nitro-group. The 2 : 4-dinitro-6-toluidine, obtained by the action of strong hydrochloric acid on dinitrotolylhydroxylamine, is a colourless substance crystallising in needles and melting at 212—213°.

158. “The synthesis of alkyl-substituted tricarballylic acids.” By W. A. Bone and C. H. G. Sprankling.

The authors have investigated two methods for the preparation of ethyl cyanotricarballylates from succinic acids, as follows: (1) By the interaction of the sodium compounds of ethyl cyanosuccinates with the esters of α-bromo-fatty acids, as indicated by the general equation (where R = hydrogen or an alkyl group)

$$CR_2Br(CO_2Et) + NaC(CN)(CO_2Et)\cdot CR_2(CO_2Et) = \\ CR_2(CO_2Et)\cdot C(CN)(CO_2Et)\cdot CR_2(CO_2Et) + NaBr,$$

and (2) by the interaction of ethyl monobromosuccinates with ethyl sodiocyanacetate, according to the equation

$$CR_2(CO_2Et)\cdot CRBr(CO_2Et) + NaCH(CN)(CO_2Et) = \\ NaBr + CR_2(CO_2Et)\cdot CR(CO_2Et)\cdot CH(CN)(CO_2Et).$$

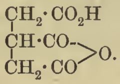
They find that whilst the first method is quite a general one and affords good yields of ethylcyanotricarballylates, the second has a more limited application (mainly on account of the tendency which ethyl bromosuccinates exhibit to lose hydrogen bromide and form unsaturated esters), and even in cases where it can be applied, the yields are not so good as those obtained by the first method. The properties of tricarballylic acid itself and a number of alkyl-substituted acids of the series, their anhydro-acids, and monomethyl salts have been studied. Some of these are indicated in the following table:

Acid.		M. p.	Dissociation constant.	M. p. of anhydro-acid.
Tricarballylic		157—159°	0·022	130—131°
α-Methyltricarballylic	(1)	179	0·0322	liquid
	(2)	134—135	0·0480	liquid
$\alpha\alpha_1$-Dimethyltricarballylic...	(1)	206—207	0·0450	110—112
	(2)	174	0·0545	130
	(3)	143	0·0572	116—117
$\alpha\alpha$-Dimethyltricarballylic ...		143	0·0318	135—136
$\alpha\alpha_1$-Di*iso*propylic..............	(1)	173	0·1930	liquid
	(2)	156	0·1625	liquid

Monomethyl salts of tricarballylic and $\alpha\alpha$-dimethyltricarballylic acids have been prepared by three methods, namely, (1) direct partial esterification of the acids, (2) partial hydrolysis of trimethyl salts, (3) the solution of anhydro-acids in methyl alcohol. The products are liquid, but a study of their dissociation constants shows that each of the three methods indicated yields a *single* monomethyl salt, and not a mixture of isomeric monomethyl salts. The dissociation constants of these salts are as follows :

Acid.	Monomethylic salts by		
	Direct esterification of acid.	Partial hydrolysis of trimethylic salt.	Solution of anhydro-acid in CH_3OH.
Tricarballylic	0·0075	0·00925	0·00945
αα-Dimethyltricarballylic ...	0·0180	0·00865	0·0186

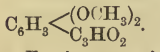
Since the monomethyl salts obtained by direct esterification of the acids most probably have the formulæ $CH_2(CO_2H)\cdot CH(CO_2H)\cdot CH_2(CO_2Me)$ and $(CH_3)_2C(CO_2H)\cdot CH(CO_2H)\cdot CH_2(CO_2Me)$ respectively (because a carboxyl attached to a *primary* carbon atom is always more readily esterified than one attached to a secondary or tertiary carbon), it follows that the monomethyl tricarballylate obtained by partial hydrolysis of the trimethyl salt, and by solution of the anhydro-acid in methyl alcohol, must have the formula $CH_2(CO_2H)\cdot CH(CO_2Me)\cdot CH_2(CO_2H)$, and therefore that the constitution of the anhydro-acid must be represented thus,



$$\begin{array}{l} CH_2\cdot CO_2H \\ | \\ CH\cdot CO\text{-} \\ | \qquad\qquad > O. \\ CH_2\cdot CO \end{array}$$

159. "Note on the constitution of limettin." By W. A. Tilden and H. Burrows.

In a previous communication (Tilden, *Trans.*, 1892, 61, 344), it was shown that limettin, $C_{11}H_{10}O_4$, had the following composition :



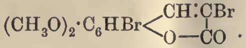
$$C_6H_3{<}\begin{matrix}(OCH_3)_2 \\ C_3HO_2\end{matrix}.$$

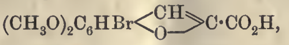
Further experiments have been undertaken, with the object of determining the structure of the group C_3HO_2.

In the meantime, the publication of a communication by E. Schmidt (*Apoth. Zeit.*, 1901, 71, 619) on a substance which he has isolated from oil of lemon and has identified with limettin, and the appearance of a recent note by Burgess (this vol., p. 171) render it necessary to place on record the following results, although at present incomplete.

The dibromo-compound previously described by Tilden (*loc. cit.*) melts at 297° with decomposition, and not at 257°.

On treatment with 10 per cent. solution of potash, it yields an acid of the composition $C_{11}H_9O_5Br$. Continued treatment with potash does not remove the second atom of bromine.

It is therefore highly probable that the structure of the group C_3HO_2 is similar to that of the ring in coumarin, dibromocoumarin behaving in exactly the same way. Dibromolimettin may therefore be represented as  $(CH_3O)_2{\cdot}C_6HBr{<}\begin{matrix}CH{:}CBr\\ O{-}CO\end{matrix}$.

When treated with potash, dibromolimettin gives the corresponding *coumarilic acid*,  $(CH_3O)_2C_6HBr{<}\begin{matrix}CH\\ O\end{matrix}{>}C{\cdot}CO_2H$, from the *potassium* salt of which the *methyl ester* was prepared (m. p. 181°).

On subjecting dibromolimettin to further action of bromine in a sealed tube, a *tribromo*-derivative was prepared containing two hydroxyl groups; the corresponding *diacetyl* compound melts at 244°.

The following chlorine compounds have been prepared:

Monochlorolimettin, which melts at 242° and is not acted upon by solutions of alkaline hydroxides. *Dichlorolimettin* melts at 275° and, like the dibromo-compound, with potash gives *monochlorocoumarilic acid.* The trichloro-derivative prepared by Tilden (*loc. cit.*) similarly gives *dichlorocoumarilic acid.*

When limettin is heated on the water-bath with a solution of sodium ethoxide, the *sodium* salt is quickly deposited. Attempts to prepare the methyl derivative were unsuccessful, but when the *silver* salt was heated with a solution of methyl iodide in methyl alcohol, a substance which crystallised in white tufts of needles (m. p. 189°) was isolated, together with re-formed limettin. Analyses showed the substance to have the formula $C_{12}H_{12}O_4$, differing from limettin by CH_2. Its chemical properties are similar to those of limettin, as it readily forms a *bromo*-derivative and a coumarilic acid.

160. "Derivatives of β-bromocamphor." By H. E. Armstrong and T. M. Lowry, D.Sc.

By heating ordinary *αα'*-dibromocamphor with hydrogen bromide under certain conditions, it is converted into an isomeric *αβ*-compound, one of the bromine atoms being transferred from the lateral CBr_2 group. Kachler and Spitzer have shown that this *αβ*-dibromocamphor is converted by nitric acid into an *αβ*-dibromonitrocamphor. The authors find that a *β*-bromocamphoric acid is also produced, isomeric with the acids described by Wreden and by Kipping and Pope. The close resemblance between this *β*-acid and the isomeric *π*-acid suggests that the two compounds are similar in constitution—perhaps stereoisomerides: in other words, that the bromine is present in one of the median methyl groups in the $-CMe_2-$ group of the camphor molecule.

β-Bromocamphoric acid, $C_8H_{13}Br(CO_2H)_2$, softens at about 205° and melts at 208—210°, gas being liberated; in a 5 per cent. solution in alcohol at 10°, $[\alpha]_D = +39{\cdot}7°$. The corresponding *anhydride*, $C_8H_{13}Br\!<\!\begin{matrix}CO\\CO\end{matrix}\!>\!O$, crystallises from dilute acetone in long, glistening needles; it melts at 142°; in a 4 per cent. solution in acetone at 10°, $[\alpha]_D = -2{\cdot}8°$.

β-Bromonitrocamphor, $C_8H_{13}Br\!<\!\begin{matrix}CH\cdot NO_2\\ |\\ CO\end{matrix}$, prepared by reducing αβ-dibromonitrocamphor, crystallises from alcohol in short prisms; when heated, it softens at 100° and melts at 112°, but after fusion and solidification remelts sharply at 100°; being a secondary nitro-compound, it forms salts; and freshly-prepared solutions exhibit the phenomena of mutarotation.

A third product of the action of nitric acid on αβ-dibromocamphor is a *tribromocamphor*, $C_{10}H_{13}Br_3O$, which melts at 66°; in a 2·5 per cent. solution in acetone, $[\alpha]_D = +2°$; it separates in a crystalline form on reducing the crude crystalline dibromonitrocamphor, and appears to be identical with the compound obtained by de la Royère by heating αβ-dibromocamphor with phosphorus pentabromide (*Bull. Soc. Chim.*, 1882, **38**, 580).

β-Bromo-derivatives of camphor are also obtained on decomposing by heat the sulphobromides derived from the "Reychler" series of acids (Armstrong and Lowry, this vol., p. 182): *e.g.* α-bromocamphor-α′-sulphobromide, $C_8H_{14}\!<\!\begin{matrix}CBr\cdot SO_2Br\\ |\\ CO\end{matrix}$, when decomposed in this way, gives αβ-dibromocamphor, $C_8H_{13}Br\!<\!\begin{matrix}CHBr\\ |\\ CO\end{matrix}$; α-chlorocamphor-α′-sulphobromide, $C_8H_{14}\!<\!\begin{matrix}CCl\cdot SO_2Br\\ |\\ CO\end{matrix}$, gives α-chloro-β-bromocamphor, $C_8H_{13}Br\!<\!\begin{matrix}CHCl\\ |\\ CO\end{matrix}$, the products obtained being identical with those formed by heating α-bromocamphor and α-chlorocamphor with bromine in sealed tubes.

ADDITIONS TO THE LIBRARY.

I. By Donation.

Hjelt, Edoard, Aschan, Ossian, Cohnheim, O., Emmerling, O., und Vahlen, E. Roscoe-Schorlemmer's ausführliches Lehrbuch der Chemie von Jul. Wilh. Brühl. Neunter Band. Braunschweig. 1901.
From the Publishers.

II. By Purchase.

Buchner, Georg. Die Metallfärbung und deren Ausführung, mit besonderer Berücksichtigung der chemischen Metallfärbung. Zweite, verbesserte, und vermehrte Auflage. Berlin. 1901.

Lindner, Paul. Mikroskopische Betriebskontrolle in den Gärungsgewerben mit einer Einführung in die technische Biologie, Hefenreinkultur, und Infektionslehre. Dritte, neubearbeitete Auflage. Ill. Berlin. 1901.

Lorenz, Richard. Elektrochemisches Praktikum. Ill. Gottingen. 1901.

van Rijn, J. J. L. Die Glykoside: chemische Monographie der Pflanzenglykoside nebst systematischer Darstellung der künstlichen Glykoside. Berlin. 1901.

Schultz, Gustav. Die Chemie des Steinkohlentheers. Dritte vollständig umgearbeitete Auflage. Zweiter Band: die Farbstoffe. Ill. Braunschweig, 1901.

Witt, Otto N. Die chemische Industrie auf der internationalen Weltaustellung zu Paris 1900. Berlin. 1902.

Pamphlets.

Imperial Department of Agriculture for the West Indies. Report on certain economic experiments conducted in connection with the Botanic Station, Antigua, 1900—1901. Barbados. 1901.

Imperial Department of Agriculture for the West Indies. Sugar-cane experiments in the Leeward Islands. Report on experiments conducted at Antigua and St. Kitts in the season 1900—1901. Part I. Experiments with varieties of sugar-cane, with an appendix on the chemical selection of sugar-cane. Part II. Manurial experiments. Barbados. 1901. From C. H. G. Sprankling.

Dymond, T. S., and F. Hughes. Notes on agricultural analyses made in the County Technical Laboratories, Chelmsford, during the years 1896—1901. From the Authors.

Patent Office. Subject list of works on certain chemical industries, including destructive distillation, mineral oils and waxes, gas lighting, acetylene, oils, fats, soaps, candles, and perfumery, paints, varnishes, gums, resins, paper and leather industries, in the Library of the Patent Office. From the Comptroller-General of Patents.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 9th.

LIBRARY CATALOGUE.

A new Catalogue of the Library, arranged under authors' names and subjects in accordance with the system adopted in indexing the Society's publications, is ready for the press. Fellows who desire a copy of the Catalogue, at a cost of 2*s*. 6*d*., are requested to send in their names to the Secretaries not later than January 31st, 1902.

If a sufficient number of names is not received, the catalogue will not be printed.

MEMORIAL LECTURES, 1893—1900.

Fellows can now obtain copies of the volume of collected Memorial Lectures on application to the Assistant Secretary, price 7*s*. 6*d*. post free.

At the next meeting, on Thursday, December 5th, there will be a ballot for the election of Fellows, and the following papers will be communicated :

"Influence of substitution on the formation of diazoamines and aminoazo-compounds." By G. T. Morgan.

"The determination of available plant food in soils by the use of dilute solvents." By A. D. Hall and F. J. Plymen.

"Some new derivatives of gallic acid." By F. B. Power and F. Shedden.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 5th, 1901.

Allen, Frederick Thomas,
15, Sea View Terrace, Hartlepool.

Teacher. For two years student at Wellingborough Technical School. Three years at Durham College of Science, Newcastle-upon-Tyne. Bachelor of Science, Durham University.

P. Phillips Bedson. C. H. Creasey.
F. C. Garrett. *S. Hoare Collins.*
J. W. Patterson. *Beeby Thompson.*

Baker, Arthur,
130, Walmersley Road, Bury, Lancs.

Works' Chemist (Paper Mill). Desirous of obtaining the Journal and keeping in touch with chemical progress. Three years' study of Advanced Chemistry and Physics at the Bury Grammar School. Attended Evening Courses in Advanced Chemistry at the Bury Technical School under W. Dixon, Esq. Silver Medallist and First Class Honours, with First Prize, in the Paper Manufacture Exam., under City and Guilds, 1901. Assisted W. French, M.A., in his private work. Two and a half years Chemist at Woolfold Paper Mill, Bury.

William French. William Dixon.
W. M. Brothers. Jul. Hübner.
Jas. Grant.

Baker, Thomas Thorne,
28, Church Road, Forest Hill, S.E.

At present studying for B.Sc., and carrying out research in connection with photo-decomposition. Have contributed articles on sensitive compounds to most of the photographic papers. Carried out research in connection with electro-chemical nature of the latent image in photo-decomposition, and read papers at some of the London Societies on the subject. Have laboratory at home specially adapted to and fitted out for this purpose. Investigated and written about the sensitive uranyl compounds, also the sensitive molybdic and tungstic salts, and their decomposition products. Am F.R.P.S., and have passed Inter. B.Sc. (Lond.).

Charles M. Stuart.
S. Barlet.
Thomas Bolas.
J. W. Shepherd.
Chapman Jones.

Ball, Walter Craven,

Trinity College, Oxford. Present Address, 19, Lewisham Hill, Lewisham, S. E.

Scholar of Trinity College, Oxford. Late Demonstrator of Chemistry, Balliol College Laboratory, Oxford. Demonstrator in Chemistry, Guy's Hospital, London. First Class Honours in Chemistry, Oxford, 1899.

[John Conroy.]
John Wade.
D. H. Nagel.
William E. Moss.
Walter C. C. Pakes.
Thos. Stevenson.
A. Vernon Harcourt.

Bennet, Andrew Russell,

1, Wildman Street, Nottingham.

Pharmaceutical Chemist. Principal of the Nottingham School of Pharmacy. Author of a "Report on Commercial Ginger, with suggestions for a Pharmacopœial Standard."

Geo. Clayton.
Edwd. Francis.
Harold B. Holthouse.
Thos. Stevenson.
Jas. Baynes.
F. Stanley Kipping.
R. M. Caven.
G. D. Lander.

Bickford, Harding,

46, Currie Street, Adelaide, S. Australia.

Manufacturing Chemist. Have studied Chemistry in Australia, and subsequently three years' analytical work at the South London Central Public Laboratory.

John Muter.
James W. Epps.
A. H. M. Muter.
Will. F. Mawer.
John C. Umney.
Fred. W. Fletcher.

Boyers, Henry,

20, Knox's Street, Sligo.

Manufacturing Chemist. Member of the Pharmaceutical Society of Ireland since 1889, by Examination. Studied Chemistry at Carmichael College, Dublin, under Professor Lapper, for two years. Am interested in Chemical Science, specially as applied to Agriculture, and am desirous of obtaining the publications of the Society.

Thomas Tyrer.	*Chas. R. C. Tichborne.*
Thomas Morson.	*Isaac S. Scarf.*
Harold W. Harrie.	*E. J. Jackman.*

Burton, William.

Cotleigh, Nunnery Fields, Canterbury.

Assistant Master, Simon Langton Schools, Canterbury. Bachelor of Science (Hons. in Chem.), Univ. of Wales, also Hons. in Chem. at Inter. Science (Lond.). Student-assistant in Chem. Laboratory of University College of Wales, Aberystwyth. Science Master in Neuenheim College, Heidelberg; and afterwards at Denstone College, Staffordshire. Now Assistant Master in School of Science at Simon Langton School, Canterbury.

H. Lloyd Snape.	Edward J. Russell.
James J. Dobbie.	*A. D. Hall.*
Humphrey O. Jones.	*John Percival.*

Cormack, William.

3, Westfield Place, Eskbank, Midlothian.

Chemist at Messrs. Annandale and Sons, Ltd., Polton Paper Works, Midlothian. Worked five years in Chemical Laboratory, University College, Dundee. Published (*a*) Apparatus for Steam-distillation (*Chem. News*, **75**, 289); (*b*) Estimation of Furfuraldehyde (*Jour. Chem. Soc.*, **77**, 990); jointly with Professor Walker: (*c*) Dissociation-constants of Weak Acids (*Jour. Chem. Soc.*, **77**, 5); (*d*) Campholytic and Isolauronolic Acids (*Jour. Chem. Soc.*, **77**, 374).

James Walker.	John H. Wigner.
John S. Lumsden.	John Foggie.

Leonard Dobbin.

Crookes, Samuel Irwin,

Thanet Street, Clay Cross, Chesterfield.

Senior Science Master, District Secondary School, Clay Cross. Pursuing the study of Chemistry in spare time at the University College, Sheffield.

W. Carleton Williams.	T. Slater Price.
George Young.	E. Witham.

William H. Oates.

Crossley, Frank,

Duchy Bank, Seedley Road, Pendleton, Manchester.

Analytical Chemist. For four years assistant to J. Carter Bell, Esq., Analyst to the County of Chester, and Boroughs of Salford, Birkenhead &c. Afterwards, during the arsenic scare in Beer, with Dr. Miller (Analyst to Brewers' Association). Since on my own account in analytical work.

J. Carter Bell.
Frank Scudder.
Alex. K. Miller.
Francis Jones.
C. Estcourt.

Davidson, John Howard,

Goldenhill, Stoke-on-Trent.

Managing Chemist to Mr. J. H. Williamson, Goldenhill Colour Works. For three years student in the Owens College Chemical Department. B.Sc. with Honours in Chemistry (Victoria), 1899. Research Student, 1899–1900.

Harold B. Dixon.
Wm. A. Bone.
D. L. Chapman.
W. H. Perkin, jun.
W. T. Lawrence.

Davis, Francis,

Whitwell, Elland, Yorks.

Director of "The Yorkshire Indigo, Scarlet, and Colour Dyers, Limited." Passed full course in Chemistry in classes connected with South Kensington. Obtained first prize Elementary, 1876, first prize Advanced, 1877, first prize Honours, 1880, in Wool-Dyeing, Soc. of Arts, and City and Guilds of Lond. Inst. Author of prize essay on "Best Chemical Methods of Treating the Waste Products in Woollen Manufacture," Cloth Workers', 1879. Author of prize essay on "Logwood, its Practical and Chemical Treatment," Cloth Workers', 1881; and take an interest in chemical progress generally.

William Ackroyd.
J. K. Crow.
Thomas J. Underhill.
Colin Gordon.
Leonard P. Wilson.
B. S. Bull.

English, Robert,

8, Colwall Villas, Burley Road, Beckenham, Kent.

Chief Chemist Crystal Palace District Gas Co., Lower Sydenham, S.E. Chief Chemist Crystal Palace D. Gas Co., two and a half years. Gas Examiner Gas Light and Coke Co., Beckton, seven years.

Samuel Rideal.
W. W. Duffield.
Vivian B. Lewes.
F. Napier Sutton.
H. F. Hills.
Walter Grafton.

Gadd, Henry Wippell,
42, Union Road, Exeter.
Analytical Chemist.

Wyndham R. Dunstan. Thos. Tyrer.
John Attfield. Arthur W. Clayden.
Benj. H. Paul.

Gillman, Edward,
Barbados, West Indies.

Chief Assistant Government Laboratory, Barbados. Analyst (Agricultural Chemistry, Sugar Chemistry, Foods and Drugs): has assisted during the past nine years in Agricultural research connected with sugar cultivation, official reports of which are published by the Barbados Government.

J. P. d'Albuquerque. John R. Bovell.
H. H. Cousins. *J. B. Harrison.*
Jno. Williams.

Groves, William Peer,
Oldfield Hall, Altrincham, Manchester.

Graduate of Cambridge University, Christ's College. B.A. with Honours in Science (Chemistry, Zoology, Botany, &c.). Two months with Dr. Miller, Ph.D., F.I.C., &c. (Manchester), during the recent "Arsenic scare." Pupil and occasional Demonstrator at Rossall School, Lancs.

Fred. R. Stone. W. B. Roberts.
Alex. K. Miller. *J. Jackson.*
J. M. Collett.

Hammond, Herbert Blackmore,
3, Vicar's Close, Lichfield, Staffs.

Assistant Brewer and Chemist to Messrs. The Lichfield Brewery Co. Ltd. Two years general chemistry, inorganic and organic, under the tuition of Mr. J. M. Murray, M.Sc., F.C.S. Private work on the analysis of foodstuffs for experience. Course of brewing chemistry under Mr. A. C. Chapman, F.I.C., F.C.S. Two years in the above position.

Alfred C. Chapman. J. Moore Murray.
Henry P. Harris. *Arthur Hartley.*
Lawrence Briant.

Harding, Herbert,

20, Stratford Road, Kensington, W.

Chemical Student. I studied chemistry for three years at Finsbury Technical College, obtaining the College Certificate, and since October, 1900, have been working under Prof. Armstrong at the Central Technical College.

Henry E. Armstrong. Gerald T. Moody.
R. Meldola. William A. Davis.
T. Martin Lowry.

Hermann, Charles Thomas Gardner,

London Hospital, E.

Chemist (Pharmaceutical). Formerly Lecturer on Chemistry, Lonsbury College, Clapton. General Interest in Chemistry and anxious to have the Society's Journal.

Frederic Jas. M. Page. John R. Brooke.
Hugh Candy. *P. Gerald Sanford.*
W. C. Young.

Hobson, Edwin,

3, Oxford Road, Liscard, Cheshire.

Analytical Chemist. Formerly student at City of London College and City Guilds Technical College. Assistant to Messrs. Cannon and Newton, 39, Mincing Lane, E.C. For the past nine years chemist and manager of the Phospho-Guano Company, Ltd., Seacombe, Cheshire.

William Newton. P. Gerald Sanford.
J. Owen Alexander. *D. G. Riddick.*
Reg. T. Marshall. *Jas. Baynes.*

Ingram, Beresford,

19, Lewisham Hill, Lewisham, S.E.

Science Master at Colfe's Gram. Sch. Science Tripos, 1900, Cambridge. Teaching Analytical Chemistry at above School. I desire to have access to the Library of the Society.

R. H. Adie. Francis Jones.
K. C. Browning. R. L. Taylor.
Edmund M. Rich.

Johnson, Charles Harold, M.B., Ch.M., F.R.C.S.E., D.P.H.,

"Beaumont," Northcote, Melbourne, Victoria, Australia.

Medical Practitioner. Diploma in Public Health (after six months' working in a chemical laboratory, at Lindsay Place). My reason for desiring Fellowship is to keep in touch with Chemistry on this side of the world. I am expecting an appointment in Public Health in Melbourne on my return.

G. H. Gemmell.	*W. Ivison Macadam.*
Alex. Crum Brown.	*J. Falconer King.*
Leonard Dobbin.	*R. R. Tatlock.*
Hugh Marshall.	*R. T. Thomson.*

Jollyman, Walter Henry,

Spartan House, Colney Hatch Lane, Muswell Hill, N.

Analyst to the Laboratory of Clinical Pathology. Three years student at Technical College, Finsbury. Assoc. Inst. of Chemistry. For two years Research Assistant to Dr. W. C. C. Pakes, F.C.S., &c. Jointly in Chemical Society's Journal, "The Collection and Examination of the Gases produced by Bacteria," "The Bacterial Decomposition of Formic Acid," "The Bacterial Oxidation of Formates by Nitrates."

Thos. Stevenson.	Walter C. C. Pakes.
John Wade.	Norman Leonard.

Otto Hehner.

Kettle, James David, B.Sc. (Lond.),

1, Vardens Road, St. John's Hill, S.W.

Chemist to the Rubber Chemical Co., Seringa Mills, Mitcham. Student at the Battersea Polytechnic for four years, at first under Dr. Bone, and later under Mr. Wilson. Assistant in Works Analytical Laboratory for four years.

William A. Bone.	Thomas Tyrer.
John Wilson.	J. W. Shepherd.
C. Edward Sage.	John Barclay.
John McArthur.	*Willie Briggs.*

Bruce-Kingsmill, Julian,

Ordnance College, Woolwich.

Captain in the Royal Regiment of Artillery (presently engaged in the Chemical Laboratory, Ordnance College, Woolwich). Certificate in Qualitative Analysis, University of Berlin. Honours in Chemistry, Intermediate Education Board, Ireland. Diploma (as Associate) Glasgow and West of Scotland Technical College. University of Glasgow, three sessions' work in Qualitative and Quantitative Analysis, including the Chemistry of Organic Compounds. Analysis of Beer; Chemistry of Explosives; Investigation of some rarer Coal Tar Products; Investigation of some Properties of Liquefied Air; Paper on "Coal Samples from the Lanarkshire Collieries."

Passed M.A. Examination in Chemistry, University of Glasgow,
Passed C.E. „ „ „ „
Passed B.Sc. „ „ (Honours) „ „ 1898.

Member of the Institution of Engineers and Shipbuilders of Scotland. Life Member Glasgow University Engineering Society, &c.

F. Nolan Baker. W. R. Hodgkinson.
Gerald T. Moody. *Bernard F. Howard.*
William A. Davis. *R. Meldola.*
William A. Lethbridge. *F. Southerden.*

Larter, Alfred Tabois,
184, Holland Park Avenue, W.

Student of Chemistry. Studied two years at the Finsbury Technical College, and two years at the Central Technical College, obtaining the Diploma of Associate of the City and Guilds Institute.

Henry E. Armstrong. T. Martin Lowry.
Gerald T. Moody. William A. Davis.
James Moir.

Macdonald, Peter,
Lapstone Road, Millom, Cumberland.

Analytical Chemist. Six years as student and assistant in laboratory of Messrs. Tatlock and Thomson, City Analysts, Glasgow, and two years Chemist to Millom Iron Works, Millom.

R. R. Tatlock. Jas. D. Dougall.
R. T. Thomson. T. K. Cockburn.
Horatio Ballantyne.

Millard, Charles Killick,
The Gilroes, Groby Road, Leicester.

Medical man. Doctor of Medicine and Doctor of Science (Edinburgh). Public Analyst for Leicester.

Alfred Hill. Jas. O'Sullivan.
C. O'Sullivan. Chas. Geo. Matthews.
Arthur L. Stern.

Miller, Edward Holl,
Common Hall, Hadleigh, Essex.

Student at Technical College, Finsbury.

Raphael Meldola. F. Southerden.
Chas. R. Darling. Bernard F. Howard.
J. Vargas Eyre.

Müller, Christian,
10, Selwyn Avenue, Richmond, Surrey.

Tutor. Studied Chemistry, Physics, and Botany at a German "Realschule" and University of Giessen. Am interested in the

Chemistry of Vegetable Physiology, and should find the Society's publications of much use. Wish, by attending the meetings and reading the Journal, to keep myself acquainted with current chemical research, here and in other countries.

Watson Smith. Oscar Guttmann.
E. G. Clayton. *Percy A. E. Richards.*
A. Percy Hoskins.

Newbould, Herbert Simpson,
Trinity Hall, Cambridge.

Undergraduate. First Class, Natural Science Tripos, 1901, Part I.

S. Ruhemann. M. M. Pattison Muir.
R. S. Morrell. *R. H. Adie.*
R. M. Caven.

Parkes, Albert Edward,
Borough Analyst's Office, 43 Whitehorse Street, Stepney, E.

Analyst to the Stepney Borough Council. For three years student at Mason College, Birmingham. For two years Chief Assistant to T. V. Hughes, Esq., F.I.C., F.C.S. For one-and-a-half years Chief Assistant to J. Kear Colwell, Esq., F.I.C., F.C.S. Fellow of the Institute of Chemistry. Member of the Society of Chemical Industry.

J. Kear Colwell. T. Slater Price.
Harry Silvester. A. Lapworth.
Percy F. Frankland. *Arthur R. Ling.*

Pollitt, Charles James Tomlin,
"Athole," Church Street, Croydon, Sydney, N.S.W.

Analytical Chemist. Studied on Science Side, Manchester Grammar School. Three years articles with Mr. Chas. Estcourt, Manchester City Analyst; eighteen months Chief Assistant Mr. Estcourt. Two-and-a-half years London Laboratory, Rio Tinto Co. Last six years Chief Chemist Laboratory of Co-operative Wholesale Society. Now Managing Chemist of Australian Works of Co-operative Wholesale Society.

W. MacKean. P. Anderson Estcourt.
Percy Haigh. J. E. Green.
Henry Bailey.

Potter, Rowland Samuel,
2, Museum Hill, Haslemere, Surrey.

Research Chemist. Associate of City and Guilds of London Institute.

For two years chemist to a tar distillery (Major and Co., Hull). At present employed in photo-chemical research.

Henry E. Armstrong. Edward W. Lewis.
William A. Lethbridge. William A. Davis.
T. M. Lowry.

Royle, Charles Leonard,
Nellikuppam, South Arcot, India.

Chemist to Sugar Refinery. Formerly student at Finsbury Technical College. Chemist one year at Abram Lyle and Sons; four years David Martineau and Co.; two years Fowler Bros.; one year Glebe Sugar Refinery; five years, and now, Chemist to East India Sugar Factories and Distillery, Nellikuppam, South Arcot, India. Wishes to keep *au courant* with Chemical Science by means of the Journal of the Society.

B. E. R. Newlands. R. Meldola.
Thomas Royle. Thos. Tyrer.
Arthur R. Ling. *F. Southerden.*

Ryffel, John Henry,
10, Onslow Gardens, Highgate, N.

Chemistry Demonstrator at Guy's Hospital. B.A. Cambridge, 1899. First Class, Chemistry, Nat. Sci. Tripos, Pt. II., 1900. B.Sc. London, 1901, First Class, Chemistry. Assistant Demonstrator at the Cambridge University Chemical Laboratory, one year, 1900—1901.

G. D. Liveing. John Wade.
W. J. Sell. F. W. Dootson.
H. J. H. Fenton. W. H. Mills.
H. O. Jones.

Sandford, Allan,
Market Place, Ulverston.

Analyst and Sampler. Second Class Diploma in Chemistry, Barrow Higher Grade School. Ten years Barrow Hematite Iron and Steel Co. Laboratory. Two-and-a-half years Pyle and Blaina Works, Ltd., Blaina, R.S.O., Mon., Laboratory. Two-and-a-half years Isle of Elba, Italy.

James E. Ferguson. A. C. Aitken.
William M'Call. Robt. D. Connell.
Rd. Spencer.

Scott, George Charlton,
Eston Grange, Grangetown, R.S.O., Yorks.

Analytical Chemist. Advanced Stage, Science and Art Exams. First Class in Practical and Second Class in Theoretical Chemistry.

Seven years of Laboratory experience. To be in touch with the most recent discoveries and advancements of the Science.

J. Archyll Jones.
J. E. Stead.
Fredk. Doyle.
C. H. Ridsdale.
H. E. Wright.

Sherwood, Edward Charles,
39, Vincent Square, Westminster.

Senior Science Master, St. Peter's College, Westminster. Late Nat. Science Demy, Magdalen College, Oxford. 2nd Class Math. Moderations; 2nd Class Final Mathematics; 2nd Class Chemistry. Four years Science Master at Magdalen College School, Oxford; two terms Science Master at Westminster School.

John Watts.
P. Elford.
J. E. Marsh.
J. A. Gardner.
H. L. Bowman.
W. W. Fisher.

Smith, Norman,
15, King Street, Bury.

Demonstrator and Assistant Lecturer in Chemistry, the Owens College, Manchester. B.Sc. with First Class Honours in Chemistry, Victoria University, 1898, after four years' study in the Owens College; Mercer Scholar, 1898; University Fellow, 1899; 1851 Exhibition Scholar, 1900. For two years worked at research in the Owens College; for one year with Professor Van't Hoff. Joint author of paper "On the Combination of Sulphur Dioxide with Oxygen" (*Journ. Chem. Soc.*, 1900).

Harold B. Dixon.
W. T. Lawrence.
W. H. Perkin, jun.
Wm. A. Bone.
D. L. Chapman.

Stephenson, Robert, jun.,
Burwell, Cambridgeshire.

Portland Cement Manufacturer. Studied Chemistry for 3 years at Cambridge, and took a degree in the Chemistry special there, period 1894—1897. Have been since then engaged in analytical work in connection with the cement industry.

W. J. Sell.
A. Hutchinson.
C. T. Heycock.
T. B. Wood.
H. J. H. Fenton.

Templeman, William Henry,
67, Park Street, Spring Bank, Hull.

I am a Student of Chemistry at Hymer's College, Hull, and the

Hull Technical School, and wish to become a Fellow of this Society, so that I shall be able to read its Journal and have access to its Library. I qualified for the University Exhibition in First Class Honours, Chemistry, Intermediate Science Exam., London, 1901.

Thomas Luxton.	Thos. A. Nightscales.
Samuel Smiles.	*Fred. E. Johnson.*

H. Irving Foster.

Varley, Harold Foy Fleetwood,

22, Strathblaine Road, New Wandsworth, S.W.

Consulting Chemist. Student in Pharmaceutical Society's School under Prof. Dunstan (1895—1896), and in the Analytical Laboratory of Messrs. Helbing and Passmore. Now in the service of the Marconi Telegraph Co.

Wyndham R. Dunstan.	H. Helbing.
Edgar E. Horwill.	William A. Bone.

John Wilson.

Wade, Frank,

36, Craven Park, Harlesden, N.W.

Analytical Chemist. Assistant Chemist, Chemical Dept., Woolwich Arsenal. A.R.C.S. (Chemistry).

W. Kellner.	Chapman Jones.
William A. Tilden.	James C. Philip.
W. Palmer Wynne.	M. O. Forster.

Wager, Morton,

5, Wilton Street, Batley.

Science Master, Batley Grammar School. Lecturer on Chemistry, Ripon Training College. Student of the Royal College of Science, 1896—1897. Inter. B.Sc. London.

J. R. Denison.	Wm. Cranfield.
A. V. C. Fenby.	I. Patchett.

A. Peacock.

Wallace, Herbert George,

Axim, West Africa; or Pall Mall Club, London.

Mining Engineer. Student at King's College Metallurgical Laboratory 1896—1897. Studied the Chemistry of the Cyanide Treatment of Gold Ores at the McArthur-Forrest Works, Glasgow. Have been employed to report for mining companies on cyanide process, and am at present Managing Engineer of the Kai Syndicate, Ltd.

A. K. Huntington.	W. J. Cousins.
George T. Holloway.	*Philip Schidrowitz.*

John S. MacArthur.

Whitehouse, Philip Lewington,

32, Lawrence St. Dowanhill, Glasgow.

Technical Chemist. Student under Professor Mills, F.R.S., D.Sc., LL.D., in Glasgow Technical College for three years. First Prize Technical Chemistry, &c. Five years and a half with Messrs. J. Storer and Co., Ltd., Paint Manufacturers, Glasgow; now as Technical Manager, in which capacity I have been engaged in many chemical investigations, one, conjointly with Dr. Mills, on utilisation of slag as pigment.

Edmund J. Mills. James Robson.
A. Humboldt Sexton. *F. H. Jennison.*
G. G. Henderson.

The following Certificates were authorised by the Council under Bye Law I (3):

Gajjar, Prof. T. K., M.A., B.Sc., M.S.C.I.,

Gingaum, Bombay.

Director, Techno-Chemical Laboratory, Bombay. Organiser and First Principal of the Kala-Bhavan (Polytechnic Institute) of Baroda. Translator of Lehne's Artificial Organic Colouring Matters and Author and Editor of different Gujrati Works and a periodical on Chemistry and Dyeing. Professor of Chemistry, Wilson College, Bombay, and Director of the Techno-Chemical Laboratory, Bombay.

H. N. Bilimoria. William Ramsay.

Jameson, J. S.,

Durban, Natal.

Senior Assistant, Government Laboratory, Natal. Three years Edinburgh University. Four years Government Laboratory.

E. Nevill.

Leahy, Albert William Denis,

Darjeeling, India.

A Major in the Indian Medical Service. Civil Surgeon and Medical Officer of Health, Darjeeling. Superintendent of the Eden Sanitarium. M.D. Univ. Dunelm, 1893. F.R.C.S. Eng., 1881. Formerly Medallist in Practical Chemistry at the Charing Cross School of Medicine. Herbert Scholar and Montifiore Prizeman Army Medical School, Netley.

Alex. Pedler.

Pay, Walter Herbert,
Durban, Natal.

Assistant Chemist, Government Laboratory. For four and a half years Assistant in the Government Laboratory, Natal, and being desirous of availing myself of the Society's publications to further my knowledge of Chemistry.

E. Nevill. W. S. Stanger Higgs.

RICHARD CLAY AND SONS LIMITED, LONDON AND BUNGAY.

Issued 10/12/01

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 243.

EXTRAORDINARY GENERAL MEETING.

Erratum in Proceedings, No. 242, p. 208, line 11 (and line 9 of the Circular Letter which accompanied it), for "the words 'the Council,'" read "the last words 'the Council,'" in accordance with text of Requisition printed on pp. 208—209.

December 5th, 1901. Mr. C. E. Groves, F.R.S., Vice-President, in the Chair.

Messrs. George Harker and T. G. Donnan were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Harry Burrows, The Green, Southgate, N.; Kenneth Macomb Chance, Lawnside, Edgbaston; William Clifford, 1, Avondale Road, Wolverhampton; John Kemp Smith Dixon, Gothic House, Birstall, nr. Leeds; Alfred Vincent Elsden, Storrington, Pulborough, Sussex; Lewis Eynon, 57, Darenth Road, Stamford Hill, N.; Frederick Ferrand, 13, Torrington Street, Hopwood, Heywood; John Oliver Ferrier, Colombo, Ceylon; George Frederick Holdcroft, 253, Oxford

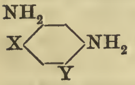
Street, Manchester; Frank Sturdy Sinnatt, Glenside, Church Lane, Moston, Manchester; Lyon Viccars Turner, Crescent Lodge, St. John's, S.E.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:—Messrs. Frederick T. Allen, B.Sc.; Arthur Baker; Thomas Thorne Baker; Walter Craven Ball, B.A.; Andrew Russell Bennett; Harding Bickford; Henry Boyers; William Burton, B.Sc.; William Cormack; Samuel Irwin Crookes; Frank Crossley, John Howard Davidson, B.Sc.; Francis Davis; Robert English; Henry Wippell Gadd; T. K. Gajjar, M.A., B.Sc.; Hermann Charles T. Gardner; Edward Gillman; William Peer Groves, B.A.; Herbert Blackmore Hammond; Herbert Harding; Edwin Hobson; Beresford Ingram, B.A.; J. S. Jameson; Charles H. Johnson, M.B., Ch.M.; Walter Henry Jollyman; James David Kettle, B.Sc.; J. Bruce-Kingsmill, M.A., B.Sc.; Alfred Tabois Larter; Albert W. D. Leahy; Peter Macdonald; Charles K. Millard, M.D., D.Sc.; Edward Holl Miller; Christian Müller; Herbert Simpson Newbould; Albert Edward Parkes; Walter Herbert Pay; Charles James Tomlin Pollitt; Rowland Samuel Potter; Charles Leonard Royle; John Henry Ryffel, B.A., B.Sc.; Allan Sandford; George Charlton Scott; Edward Charles Sherwood, M.A.; Norman Smith, B.Sc.; Robert Stephenson, jun., B.A.; William Henry Templeman; Harold Foy F. Varley; Frank Wade; Morton Wager; Herbert George Wallace; Philip Lewington Whitehouse.

Of the following papers, those marked * were read:

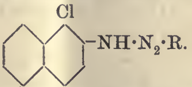
*161. "Influence of substitution on the formation of diazoamines and aminoazo-compounds." By G. T. Morgan, D.Sc.

The disubstituted derivatives of *m*-phenylenediamine having one free para-ortho-position with reference to the amino-radicles interact readily with diazonium salts, giving rise to aminoazo-compounds in almost theoretical quantities. The diamines of the general formula



having substituents in both the para-ortho-positions do not easily condense with diazonium salts, and the yield of amino-azo-compound is very poor.

The bases of both series, however, combine with primulin diazotised on the cotton fibre, the diamines of the first series giving rise to reddish-brown azo-compounds, whilst those of the second series furnish colouring matters having a brownish-yellow tint.

Although the interaction of β-naphthylamine and a diazonium salt leads to the direct formation of an *o*-aminoazo-derivative containing the diazo-residue $R{\cdot}N_2{-}$ in the α-position contiguous to the amino-group, yet 1-chloro-2-naphthylamine, under similar conditions, yields stable diazoamines of the type 

In this compound, the azo-group has no tendency to shift into the aromatic nucleus, this transference being apparently prevented by the presence of the chlorine atom in the adjacent ortho-position.

The following acyl derivatives were prepared in characterising certain of the diamines employed in this investigation. *Diformyl*-4 : 6-*diamino*-1 : 3-*xylene*, needles, m. p. 182—183°, the corresponding *diacetyl* and *dibenzoyl* derivatives, m. p. respectively at above 260° and 253°; *diformyl*-2 : 4-*diamino*-1 : 3-*xylene*, m. p. 219—220°, the *diacetyl* derivative, m. p. above 260°, and the *dibenzoyl* derivative, m. p. 232°; *diformyl*-5-*chloro*-2 : 4-*tolylenediamine*, silky needles, m. p. 166°, the *benzoyl* derivative, m. p. 205°.

The following azo-compounds were produced in illustrating the behaviour of the two series of diamines towards diazonium salts. *Benzene*-5-*azo*-2 : 4-*diamino*-1 : 3-*xylene*, readily produced from 2 : 4-diamino-1 : 3-xylene, brown needles, m. p. 208—209°; its *diacetyl* derivative, m. p. above 260°; *diacetylbenzene*-5-*azo*-2 : 4-*tolylenediamine*, m. p. 216—217°.

Benzene-5-*azo*-4 : 6-*diamino*-1 : 3-*xylene*, obtained with some difficulty and in small yield from 4 : 6-diamino-1 : 3-xylene, forms deep red plates, m. p. 182—183°; its *diacetyl* derivative, m. p. above 260°. p-*Toluene*-5-*azo*-4 : 6-*diamino*-1 : 3-*xylene* resembles its lower homologue and melts at 165—166°. Small yields of *benzene*-3-*azo*-5-*chloro*-2 : 4-*tolylenediamine* and its p-*toluene homologue* are produced from 5-chloro-2 : 4-tolylenediamine; they crystallise in dark, brownish-red plates, m. p. 147° and 152° respectively; the *dibenzoyl* derivative of the former azo-compound melts at 236—237°.

Benzene-6-*azo*-2-*chloro*-3 : 5-*tolylenediamine*, obtained in theoretical quantity from 2-chloro-3 : 5-tolylenediamine, forms orange-red, acicular prisms, m. p. 134°; its *diacetyl* and *dibenzoyl* derivatives crystallise in orange-coloured needles, m. p. 251° and 233° respectively.

1-Chloro-2-naphthylamine yields the following diazoamines when treated with the appropriate diazonium chloride. 2-*Diazoamino*-1-*chloronaphthalene*, $ClC_{10}H_6{\cdot}N_3H{\cdot}C_{10}H_6Cl$, produced by the action of

1-chloro-2-naphthalenediazonium chloride, crystallises in golden-yellow needles, m. p. 152°.

p-*Nitrobenzene*-2-*diazoamino*-1-*chloronaphthalene*,

$$NO_2\cdot C_6H_4\cdot N_3H\cdot C_{10}H_6Cl,$$

obtained from *p*-nitrobenzenediazonium chloride and 1-chloro-2-naphthylamine, or from 1-chloro-2-naphthalenediazonium chloride and *p*-nitraniline, crystallises in brownish-yellow leaflets; it melts and decomposes at 197—198°. Its production by the two processes indicated shows that Kekulé's rule for the formation of mixed benzenoid diazoamines applies also to those containing naphthalene residues. The *ethyl* derivative, produced by the direct ethylation of the preceding compound, separates from benzene in hard, yellow, prismatic crystals, m. p. 193—194°.

DISCUSSION.

Mr. EVERSHED asked whether the primulin compounds described were only obtainable on the fibre, and if so, whether similar compounds could be obtained outside the fibre by using dehydrothioparatoluidine instead of primulin.

Dr. HEWITT inquired whether the author expected to obtain three distinct ethyl derivatives of unsymmetrical diazoamino-compounds, or whether the derivative obtained by alkylation would not be a mixture of the other two ethyl derivatives obtained by coupling diazotised amines with monoethylamines. Such cases had already been observed by Meldola. The earlier idea that in the benzene series *p*-azo-compounds exclusively result when the para-position is free can no longer be held to be absolutely true. Bamberger (*Ber.*, 1900, 33, 3188) has obtained small quantities of ortho-oxyazobenzene mixed with a large amount of the para-isomeride by the action of a phenyldiazonium salt solution on an alkaline solution of phenol.

Dr. MORGAN, in reply, said that the colouring matters produced from diazotised primulin were obtained only on the cotton fibre, this reaction being employed merely as a ready means of ascertaining whether the symmetrically disubstituted diamines react with diazo-compounds. The substances prepared by the action of the simpler diazonium salts (benzenediazonium chloride and its *p*-tolyl homologue) on these bases have the appearance of true azo-compounds; they are readily acetylated and benzoylated without decomposition, and withstand prolonged digestion with boiling hydrochloric acid, either in aqueous or alcoholic solutions, just like the isomeric azo-derivatives obtained from the diamines, in which the diazo-residue enters the ring in a para-ortho-position with respect to the amino-radicles.

*162. "The determination of available plant food in soils by the use of dilute solvents." By A. D. Hall and F. J. Plymen.

The use of various weak acid solvents has been suggested in the analysis of soils, as dissolving out the mineral plant food which may be regarded as immediately "available" for the crop.

In order to ascertain which acid would give the most "critical" results, as judged by the known history of the soil, the authors have determined the phosphoric acid that could be extracted from nineteen different soils by a 1 per cent. solution of citric acid, by equivalent solutions of hydrochloric and acetic acids, by a saturated solution of carbonic acid and by an ammoniacal solution of ammonium citrate respectively. Seven of the soils were from plots on the Broadbalk field, Rothamsted, which had been continuously manured in the same manner for 42 years previously; the remaining twelve were soils of very various origin, which had been the subject of crop experiments and of which the reaction to phosphatic manuring was well marked. In the same seven soils from the Broadbalk field the authors determined the potash extracted by the same solvents, with the exception of ammonium citrate; five other soils of different origin, whose response or otherwise to potash manuring had been tested by experiment, were also examined. Determinations were made of the phosphoric acid and potash dissolved after long digestion with strong hydrochloric acid, of the loss on ignition and of the earthy carbonates present in each soil.

The acids did not attack the phosphates and potash in the same way; in the case of phosphoric acid most was dissolved by citric acid, in the case of potash by hydrochloric acid; water charged with carbonic acid generally dissolved less than the other solvents. In all cases the weak acids gave better indications of the need of the soil for special mineral manuring than was afforded by the determination of the total phosphoric acid or potash present.

Though, as a rule, all the acids gave similar indications as to the relative fertility of the soils, as regards the mineral matters under consideration, certain differences exist in their modes of attack; for example, from the soil of the Broadbalk field, which had received an annual dressing of dung for 42 years, the weak hydrochloric acid extracted a comparatively smaller proportion of phosphoric acid than the other solvents; hydrochloric acid again had relatively slight action on the phosphates of the nitrated plots. The strength of the acids used affected the amount of phosphoric acid dissolved, and the addition of calcium carbonate to the soil diminished the amount dissolved by citric, but not by acetic or carbonic acids.

Though the differences in the rate of attack which the various acids exhibit in dealing with soils of a different type are related to the varying states of combination of phosphoric acid or potash in the soils, there is still sufficient likeness in the indications afforded by all the acids to negative the idea that any one acid can be found which will discriminate sharply between the "available" and "non-available" mineral plant food.

The authors conclude:

(1) That no sharp distinction can be drawn between "available" and "non-available" phosphoric acid and potash in the soil, and that any process for determining the "available" constituents is an empirical one, dependent on the strength and nature of the acid used.

(2) That the weak solvents give information as to the requirements of a given soil for mineral manures of a far more trustworthy nature than that which is afforded by such a solvent as strong hydrochloric acid.

(3) That of the acids examined, the 1 per cent. solution of citric acid gives results most in agreement with the recorded history of the soil, though there is evidence that the same interpretation cannot be put on results obtained from all types of soil.

DISCUSSION.

Dr. **ARMSTRONG** said the only way in which the method advocated could be tested was to compare the laboratory results with those afforded by field experiments such as had been made at Rothamsted; and it was remarkable how general was the agreement in that case. But he felt less happy after listening to the account given of this work with other soils: the results did not appear to be so uniformly in favour of Dr. Dyer's method. The conditions offered by soils were obviously very complicated, and it was difficult to believe that so simple a test could afford really comparable results in all cases, especially when applied to soils varying greatly in character. But the case was one in which the decision must be based on considerable experience. Dr. Armstrong took exception to the authors' use of curves in expressing their results, and suggested that only vertical ordinates should be plotted.

Mr. T. S. **DYMOND** said that this paper was particularly interesting, as one of the soils was a London clay from the "derelict" grass land of Essex, from a field which manurial trials had shown to be almost devoid of available phosphoric acid. When superphosphate of lime was used, a dressing of nitrate of soda had doubled the produce of hay, while in its absence nitrate of soda failed to give any increase at all. The citric acid-soluble phosphoric acid in the top nine inches of soil amounted, as shown by the authors, to 200 lbs. per acre, while the crop was able to remove no more than 2 lbs., leaving, apparently, no further available phosphoric acid in the soil. Although that quantity might be potentially "available" in the soil, it was not actually available in such land as this, until, by improving its mechanical condition, air was admitted, fermentation encouraged, and carbonic acid produced. The experiment also indicated that the acidity of the root sap of the grasses and clovers had little, if any, effect in dissolving "available" phosphate. Both on this ground and on the ground that the carbonic acid-soluble phosphoric acid, as shown by the authors, was much lower than the citric acid-soluble phosphoric acid, the use of carbonic acid as a solvent would appear to give a truer idea of the amount of phosphoric acid actually available. No conclusion as to the manurial requirements of such land should be drawn without also taking into account the various circumstances favourable to carbonic acid production.

Mr. F. J. LLOYD said that, as in the case of Dr. Dyer's paper (*Proc.*, 1894, 10, 36), no steps seemed to have been taken to allow for the alkaline reaction of the soil. In the 200 grams used by the authors there might easily be present 4 grams of calcium carbonate, a quantity which would materially affect the 20 grams of citric acid in 2 litres of solution, so that the soil was not really subjected to the action of a 1 per cent. solvent.

Mr. HALL said, in reply, that the effect produced by calcium carbonate in the soil had not been overlooked. The authors had used a soil to which successive additions of 2, 5, and 10 per cent. of calcium carbonate were made before treating with the dilute acid. The amount of phosphoric acid dissolved by the citric acid was diminished with each addition of calcium carbonate, but the attack of acetic and carbonic acids was practically unchanged. The diminution was not, however, proportional to the neutralisation of the acid, because neutral saline solutions themselves had a solvent effect, dissociation doubtless coming into play.

There were discrepancies still to be cleared up in the results furnished by citric acid; probably as was indicated in the paper, for different types of soil different 'limits' would have to be taken as indicative of the need of mineral manures.

*163. "On a method for determining small quantities of carbonates."

By A. D. Hall, and E. J. Russell.

The authors have devised an apparatus for determining small quantities of carbonates in material like soil by measuring the carbon dioxide evolved. The material is placed in a small bulb, the volume of which need not be known, in which the pressure is reduced to an approximate vacuum; the carbonate is decomposed by the admission of dilute sulphuric acid, and the change in pressure thus produced is noted. Connection is then made with a second vacuous bulb of known volume, and the change in pressure again read. From the two changes in pressure the volume of carbon dioxide can be calculated. A knowledge of the volume of the material is not required, and the volume of the carbon dioxide which dissolves in the reacting liquid does not enter into the calculation since the liquid practically forms part of the unknown volume of the first bulb.

Examples are given of the measurements of carbon dioxide evolved from pure carbonates in known quantity ranging from 0·13 c.c. to 11·26 c.c.

164. "Derivatives of gallic acid." By F. B. Power and F. Shedden.

The authors have prepared and described the following derivatives of gallic acid.

Ethyl dinitrodiacetylgallate, $C_6(NO_2)_2(C_2H_3O_2)_2OH\cdot CO_2C_2H_5$, was prepared by the nitration of ethyl triacetylgallate, m. p. 133°. It forms lemon-yellow needles, m. p. 165°.

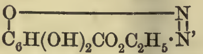
Ethyl dinitrotriacetylgallate, $C_6(NO_2)_2(C_2H_3O_2)_3\cdot CO_2C_2H_5$, was prepared from the preceding compound by the action of acetic anhydride. It forms colourless needles, m. p. 145—146°, which gradually become yellow. Its cold alcoholic solution gives no reaction with ferric chloride, but, on boiling, a bluish-green colour is produced.

Ethyl dinitrogallate, $C_6(NO_2)_2(OH)_3\cdot CO_2C_2H_5$.—When an alcoholic solution of ethyl dinitrodiacetylgallate is boiled with sodium ethoxide and allowed to stand, the *sodium salt* of *ethyl dinitrogallate* was deposited as a bright red, crystalline powder. From the aqueous solution of the latter, hydrochloric acid precipitates ethyl dinitrogallate in the form of small, yellow scales which melt at 153—154°. The same compound was obtained by boiling ethyl dinitrodiacetylgallate with 50 per cent. sulphuric acid.

Ethylmonamidogallate hydrochloride,

$$C_6H(NH_2)(OH)_3\cdot CO_2C_2H_5,HCl,H_2O,$$

was obtained, together with the diamido-derivative, by the reduction of ethyl dinitrogallate with tin and hydrochloric acid. It forms white, needle-shaped crystals, which melt at 210° with decomposition. It can be precipitated from its aqueous solution by the addition of strong hydrochloric acid.

Diazoethylgallate,  $\begin{array}{l}O\text{———————}N\\ \vert \qquad\qquad\qquad\quad \Vert\\ C_6H(OH)_2CO_2C_2H_5\cdot N\end{array}$, was obtained by the action of nitrous acid on ethyl monamidogallate. When recrystallised from dilute acetic acid it forms fine, reddish-brown needles, which melt with sudden decomposition at 182°. When heated with water in a sealed tube at 220° for four hours, the nitrogen is completely eliminated and ethyl gallate is produced.

Ethyl diamidogallate hydrochloride, $C_6(NH_2)_2(OH)_3 \cdot CO_2C_2H_5,2HCl$, was obtained, together with the above described monamido-derivative, by the reduction of ethyl dinitrogallate. It melts with decomposition at 197°, and is very easily oxidised. It dissolves readily in water, and the solution almost immediately becomes blue, the colour being intensified by the addition of a very little ferric chloride, but destroyed by an excess.

165. "Note on phosphorus suboxide." By K. C. Browning, M.A.

The author has investigated the following methods used to prepare so-called phosphorus "suboxide."

(i) Oxidation of phosphorus, both in the solid state and in solution, by air diluted with carbon dioxide.

(ii) Action of metals on phosphorus oxychloride.

(iii) Action of acetic anhydride on sodium hypophosphite.

The results obtained confirm, on the whole, those of Chapman and Lidbury and of Burgess and Chapman, although the author believes that the suboxide *can* exist under certain conditions.

166. "The bromination of trimethylsuccinic acid and the interaction of ethyl bromotrimethylsuccinate and ethyl sodiocyanacetate." By W. A. Bone and C. H. G. Sprankling.

When trimethylsuccinic acid is heated under pressure to 130° with the calculated quantity of bromine, it is converted into the characteristic white *bromotrimethylsuccinic anhydride,* m. p. 197—198°. On the other hand, if the bromination be carried out according to the Hell-Volhard-Zelinsky (phosphorus and bromine) method and the product be poured into alcohol, a mixture of the bromoanhydride and *ethyl bromotrimethylsuccinate* results, from which it is difficult to obtain the latter substance in a tolerably pure state.

On heating the bromoanhydride with diethylaniline, hydrogen bromide is eliminated, and on afterwards pouring the liquid into a solution of potassium hydroxide, the potassium salt of *methylenedimethylsuccinic acid,* $(CH_3)_2C(CO_2H) \cdot C(CO_2H):CH_2$, is obtained. The acid melts at 140—141°, its diethyl salt boils at 173—176° (755—760 mm.) and readily absorbs bromine and hydrogen bromide in the cold.

Ethyl bromotrimethylsuccinate reacts with ethyl sodiocyanacetate with the formation of the cyano-ester which on hydrolysis yields a tribasic acid, $C_9H_{14}O_6$, melting at 137—138°. This acid is not *i*-camphoronic (*aaβ*-trimethyltricarballylic) acid (m. p. 169—173°), which would have resulted had the reaction proceeded normally, thus:

$$(CH_3)_2C(CO_2Et)\cdot C(CH_3)Br(CO_2Et) + NaCH(CN)(CO_2Et) = (CH_3)_2C(CO_2Et)\cdot C(CH_3)(CO_2Et)\cdot CH(CN)(CO_2Et) + NaBr.$$

Most probably the acid is the isomeric *aa-dimethylbutane aa′β-tricarboxylic acid*, a view which the authors' experiments so far justify, and its formation is explained on the supposition that ethyl bromotrimethylsuccinate, in contact with ethyl sodiocyanacetate, loses hydrogen bromide, forming ethyl methylenedimethylsuccinate, which immediately condenses with ethyl cyanacetate as indicated by the equation:

$$(1)\ (CH_3)_2C(CO_2Et)\cdot C(CH_3)Br(CO_2Et) = HBr + (CH_3)_2C(CO_2Et)\cdot C(CO_2Et){:}CH_2.$$

$$(2)\ (CH_3)_2C(CO_2Et)\cdot C(CO_2Et){:}CH_2 + CH_2(CN)(CO_2Et) = (CH_3)_2C(CO_2Et)\cdot CH(CO_2Et)\cdot CH_2\cdot CH(CN)(CO_2Et).$$

The further investigation of the new acid is now being prosecuted.

167. "β-Bromocamphor." By H. E. Armstrong and T. M. Lowry.

The formation of derivatives of β-bromocamphor on decomposing by heat the sulphobromides of the Reychler series of substituted camphorsulphonic acids has been described in a previous notice (this vol., p. 217). On treating the unsubstituted sulphobromide in a similar manner, in the spring of the present year, a bromocamphor was obtained, which melted at 76°, very similar to ordinary bromocamphor; but as the melting point of a mixture of the two substances was 65°, it was clear that they were not identical. By further purification of the substance, the melting point was raised to 79°. The optical rotatory power of the new compound is very different from that of α-bromocamphor, a solution in acetone containing 3·3 per cent. giving $[\alpha]_D = 18°$, the corresponding value for the α-bromocamphor being 143°.

Recently, larger quantities of material have been prepared, and proof has been obtained that the new bromocamphor is the parent term of the β-series by its direct oxidation into β-bromocamphoric acid.

Simultaneously with the authors, Dr. M. O. Forster has obtained β-bromocamphor by simply brominating the isomeride of camphor which he has described under the name of hydroxycamphene. A direct comparison of the products from the two sources has been made, which leaves no doubt as to their identity. Dr. Forster's observations are described independently.

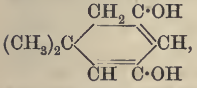
168. "β-Bromocamphor." By M. O. Forster.

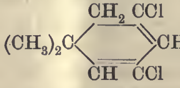
When 1-hydroxycamphene (*Trans.*, 1901, 79, 644), dissolved in glacial acetic acid containing sodium acetate (1½ mols.), is treated with a solution of bromine (1 mol.) in the same solvent, water precipitates a new bromocamphor, which, from the fact that bromine converts it readily into β-dibromocamphor melting at 114°, must be regarded as the monobromocamphor which has the substituent in the unknown β-position. The bearing which this observation has upon the constitution of 1-hydroxycamphene will be discussed in a future communication.

β-Bromocamphor, $C_{10}H_{15}OBr$, crystallises from alcohol in long, colourless, prismatic needles and separates from petroleum in transparent, well-formed prisms; it melts at 78°, has $[\alpha]_D = +19°$ in alcohol and $[\alpha]_D = +16°$ in chloroform. Alcoholic potash eliminates bromine from the substance and converts it into an unsaturated acid which belongs probably to the campholenic series. The *oxime* crystallises from alcohol in lustrous, rhomboidal plates, which melt at 156°.

169. "Substituted Dihydrobenzenes. Part I." By A. W. Crossley and H. R. Le Sueur.

When 2:6-diketo-4:4-dimethylhexamethylene (dimethyldihydroresorcinol) is treated with phosphorus pentachloride, both oxygen atoms are removed apparently as hydroxyl groups, giving rise to 2:6-*dichloro*-4:4-*dimethyldihydrobenzene*, a colourless, highly refractive liquid,





boiling at 91° at 23 mm. It has a faint odour of turpentine, resinifies slowly on exposure to air, and on boiling with dilute sulphuric acid is reconverted into dimethyldihydroresorcinol. When treated with sodium in moist ethereal solution, both chlorine atoms are replaced by hydrogen atoms and there results 4:4-*dimethyldihydrobenzene*, a clear, colourless, mobile liquid, with a marked odour of turpentine, boiling at 111°. It is homologous with the terpenes, which it resembles in chemical behaviour. Thus it decolorises a solution of bromine in chloroform; concentrated sulphuric acid produces a blood red colour, changing to violet on standing, and with hydrogen bromide it gives a crystalline *hydrobromide.*

Its properties are being thoroughly investigated, and other similar hydrocarbons are being prepared.

170. "The part played by residual affinity in the formation of substitution derivatives. The orienting influence of sulphur." By H. E. Armstrong and E. Horton.

In previous notices, it has been argued that the formation of ortho- and para-substitution derivatives from phenolic and aminic compounds is due to the attractive influence exercised by the oxygen and nitrogen respectively, and experimental evidence has been adduced which shows that if the phenolic or aminic hydrogen be displaced by hydrocarbon or acid radicles, the "activity" of the oxygen or nitrogen is more or less diminished, if not entirely destroyed; in other words, that the "residual affinity" of the negative element becomes weakened in some cases to the point of being inoperative (compare *Proc.*, 1899, **15**, 176; 1900, **16**, 157; *B.A. Report*, 1899, 683).

Although applied to the explanation of the formation of substitution derivatives generally as far back as 1887 (*Trans.*, **51**, 268), the doctrine of "residual affinity" has not hitherto received the attention it perhaps deserves in this connection; we seem to have forgotten that the conception that addition precedes substitution dates back at least to Kekulé's famous paper on the valency of carbon (1858). But now that the doctrine of residual affinity has been rediscovered in Germany by Thiele, and advocated by von Baeyer (*Ber.*, 1901, **34**, 2686), it appears likely to become the fashion, and there is some chance that at last justice may be done to the peculiar qualities of the negative elements; the tendency at the moment to credit oxygen with full tetrad functions is proof, however, that unless care be taken the doctrine will be pushed to unwarrantable extremes.

In studying the influence of residual affinity, sulphur is an element of peculiar interest deserving of far more attention than it has hitherto received; its lethargic behaviour in benzenoid compounds is especially remarkable. To obtain further knowledge of these compounds, the authors are engaged in contrasting the thiobenzenoid ethers with the corresponding oxygen ethers.

Methyl and ethyl phenylsulphides are readily sulphonated, yielding para-acids, which afford well-defined salts, &c. On oxidation by permanganate, the thiosulphonates are converted into corresponding sulphonesulphonates. If an aqueous solution of the thiosulphonate be subjected to the action of bromine, it is converted wholly into the corresponding sulphoxide-sulphonate; for example, $EtS{\cdot}C_6H_4{\cdot}SO_3K + Br_2 + OH_2 = EtSO{\cdot}C_6H_4{\cdot}SO_3K + 2HBr$, the bromine acting only as an oxidising agent. As it was probable that oxidation was due to the formation of hypobromous acid, in the expectation that if this were prevented from forming, bromine would be without action, the salt was brominated in presence of muriatic acid; under these conditions, the salt was converted entirely into the ortho-bromothio-sulphonate. It seems, therefore, that, if prevented from undergoing oxidation, sulphur may behave as oxygen does; but the thioether-sulphonates are far more stable than the oxygen-ether-sulphonates, as the sulpho-group is not displaced from them by bromine.

Mr. Lewis has ascertained that muriatic acid has, in some cases, a distinct influence on the course of change on brominating the oxygen-ether-sulphonates, and that it promotes the formation of the orthobromosulphonate whilst diminishing the extent to which the sulphonic group is displaced.

ADDITIONS TO THE LIBRARY.

I. By Donation.

Church, A. H. The Chemistry of Paints and Painting. Third edition, revised and enlarged. 8vo, pp. 355. London. 1901.
From the Author,

Goppelsroeder, Friedrich. Capillaranalyse, beruhend auf Capillaritäts- u. Adsorptionserscheinungen, mit dem Schlusskapitel: das Emporsteigen der Farbstoffe in den Pflanzen. Mit 59 Tafeln. 8vo, pp. 545. Basel. 1901. From the Author.

van't Hoff, J. H. Vorlesungen über theoretische und physikalische Chemie. Erstes Heft: die chemische Dynamik. Mit in den Text eingedruckten Abbildungen. Zweite Auflage. 8vo, pp. 251.
From the Author.

II. By Purchase.

Fischer, Ferdinand. Die Brenstoffe Deutschlands und der übrigen Länder der Erde und die Kohlennoth. Mit einer graphischen Darstellung. 8vo, pp. 107. Braunschweig. 1901.

von Georgievics, Georg. Lehrbuch der Farbenchemie. Zweite Auflage. 8vo, pp. 449. Leipzig und Wien. 1902.

Neumann, Bernhard. Gasanalyse u. Gasvolumetrie. Mit 116 Abbildungen. 8vo, pp. 168. Leipzig. 1901.

Stenglein, M. Handbuch der Presshefen-Fabrikation. Erste Abtheilung: die Apparate u. Einrichtung von Presshefefabriken, mit 251 Abbildungen. Zweite Abtheilung : das chemische u. das mikroskopische Laboratorium des Hefebrenners, mit 125 Abbildungen u. 12 Tafeln (*being* Nos. 61 and 62 of Bolley's Technologie, Bd. iv, 5, 1, 2). 8vo, pp. 327, 279. Braunschweig. 1901.

LIBRARY CATALOGUE.

A new Catalogue of the Library, arranged under authors' names and subjects in accordance with the system adopted in indexing the Society's publications, is ready for the press. Fellows who desire a copy of the Catalogue, at a cost of 2*s.* 6*d.*, are requested to send in their names to the Secretaries not later than January 31st, 1902.

If a sufficient number of names is not received, the catalogue will not be printed.

MEMORIAL LECTURES, 1893—1900.

Fellows can now obtain copies of the volume of collected Memorial Lectures on application to the Assistant Secretary, price 7*s.* 6*d.* post free.

At the next ordinary meeting, on Thursday, December 19th, the following papers will be communicated:

"Corydaline. Part VII. The constitution of corydaline." By J. J. Dobbie, M.A., D.Sc., and A. Lauder, B.Sc.

"The relation of corydaline to berberine. The oxidation of berberine with nitric acid." By J. J. Dobbie, M.A., D.Sc., and A. Lauder, B.Sc.

"The magnetic rotation of some polyhydric alcohols, hexoses, and disaccharoses." By W. H. Perkin, sen., Ph.D., F.R.S.

"Stereoisomeric halogen derivatives of *a*-benzoylcamphor." By M. O. Forster and F. M. G. Micklethwait.

"Is argon an elementary substance?" By G. Martin.

RICHARD CLAY AND SONS LIMITED LONDON AND BUNGAY

Issued 31/12/01

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 17. No. 244.

Extraordinary General Meeting, December 12th, 1901. Professor Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

The President stated that this meeting had been convened in accordance with a requisition signed by 128 Fellows of the Society and that the following motions would be proposed:

(1) On line 7 of Bye-Law XI (page 21, fifth line from top) to delete the words "the Council" and insert in their place the words "an Extraordinary General Meeting of the Society."

(2) To resolve that the Ordinary Meetings of the Society shall continue to take place, as heretofore, on Thursdays, at 8 p.m.

Motion (1) was proposed by Mr. Hehner and seconded by Mr. Pakes.

Professor Frankland proposed, and Professor Ramsay seconded, the following amendment:

"That this meeting desires to express its continued confidence in he Council as the Executive of the Society, as it has no reason to doubt hat all the business of the Society, including the selection of days and ours of meeting, will be managed as heretofore in the interests of he Society as a whole and in accordance with the wishes of the ajority of the Fellows."

After a discussion in which the following Fellows took part: Dr. ivers, Mr. A. H. Allen, Mr. D. L. Howard, Professor Smithells, r. Lewkowitsch, Professor Dewar, Professor Warington, and Mr. hipson Beale, K.C., the President asked for a show of hands and clared the amendment carried. A poll having been demanded, the resident announced that it would be taken by means of cards wing "For" and "Against" printed on them, with a space for the signature of the Fellow voting, one of these words to be deleted. Mr. Heycock, Dr. Hewitt, Dr. Shields, and Dr. Travers, having been appointed scrutators,

The PRESIDENT announced that the votes were, for the amendment, 128; against, 120.

The PRESIDENT then declared the following carried:

"That this Meeting desires to express its continued confidence in the Council as the Executive of the Society, as it has no reason to doubt that all the business of the Society, including the selection of days and hours of meeting, will be managed as heretofore in the interests of the Society as a whole and in accordance with the wishes of the majority of the Fellows.

December 19th, 1901. Prof. J. EMERSON REYNOLDS, F.R.S., President, in the Chair.

Messrs. Kiddell, Larter, Harding, and H. C. T. Gardner were formally admitted Fellows of the Society.

The SECRETARY read the following Address which was presented on November 24th to Professor Berthelot in the name of the Chemical Society by the President, who was accompanied by Dr. Gladstone and Professor Ramsay, as the representatives of the Society.

To M. MARCELLIN BERTHELOT, *Senator, late Minister for Foreign Affairs, Member of the Institute.*

SIR,

On behalf of the President, Officers, Council, and Fellows of the Chemical Society, we beg to offer you, the Senior Foreign Member of our Society, our heartiest congratulations on the occasion of the Fiftieth Anniversary of your first scientific publication.

The Chemical Society has recently received the first volumes of your monumental work, yet to be completed, including the great number of papers which you have contributed, during fifty years of scientific activity, to the Chemistry of the hydrocarbons and their methods of formation.

There is, however, scarcely any department of Chemical Science in which you have not worked as a pioneer with distinguished results, whilst to you is largely due the foundation of a new branch of the Science, namely, Thermo-Chemistry.

Alike in the history of our Science, and in its applications to Agriculture and Industry, you have made brilliant contributions.

We trust that for many years you may possess the health and strength to continue those investigations which have made your name famous throughout the Scientific world.

Signed, on behalf of the Chemical Society,

J. EMERSON REYNOLDS, *President.*
WILLIAM A. TILDEN, *Treasurer,*
WYNDHAM R. DUNSTAN, } *Secretaries.*
ALEXANDER SCOTT, }
RAPHAEL MELDOLA, *Foreign Secretary.*

November 22nd, 1901.

DAY AND HOUR OF MEETING.

The President announced that at the Meeting of Council held this afternoon, the following resolution was unanimously adopted:

"That having regard to the discussion which took place at the Extraordinary General Meeting on December 12th, the Council resolves to make the experiment of holding the Ordinary Meetings, as far as possible, alternately at 5.30 p.m. on Wednesdays, and at 8 p.m. on Thursdays, from January, 1902, until the end of the present session in June, instead of holding meetings on Wednesdays at 5.30 p.m. only during the period from January to March, 1902, as stated in the resolution of July 4th, 1901, which is hereby rescinded,"

and that a Committee had been appointed consisting of the President, the Treasurer, the Senior Secretary, Dr. Armstrong, Professor Dobbie, and Dr. Forster to arrange the exact dates on which future meetings during the session should be held.

The next Ordinary Meeting of the Society will be held on Thursday, January 16th, at 8 p.m.

It was also announced that Sir Henry Roscoe had presented a plaster cast of the bronze portrait on Bunsen's tomb in Heidelberg, and that a photograph of a bas-relief of Professor Julius Thomsen had been presented to the Society by Mr. Harald Faber.

Certificates were read for the first time in favour of Messrs. Evelyn Andros de la Rue, 52, Cadogan Sq., S.W.; Keith Benham Benham, Deans Hall, Stafford; William Dennis, Ocean Road Pharmacy, South Shields; Paul Haas, 11, Westbourne Park Rd., W.; Eugene Edwin Hennesey, Bigods, Dunmow, Essex; William Holdsworth Hurtley, St. Bartholomew's Hospital, E.C.; David Smith Jardin, Rathgar House, Rathgar; Harry Lucas, 1, St. Agnes' Place, Kennington Park, S.E.; John Ross MacKenzie, 31, Bailey St., Ton-Pentre, Glam.; William Maitland, 236, Brookhill, Sheffield; Francis Martin, 64, Samuel St., Woolwich; Francis Hylton Molesworth, Turramurra, Sydney, N.S.W.; Alfred Holley Mundey, 17, St. Margaret's Rd., Plumstead; Robert Eley Blake Smith, 93, Upper Richmond Rd., Putney, S.W.; William Southworth, County Council Farm, Hutton, Preston, Lancs.

Of the following papers those marked * were read:

*171. "Corydaline. Part VII. The constitution of corydaline." By J. J. Dobbie, D.Sc., M.A., and A. Lauder, B.Sc.

The decomposition products of corydaline have been studied by the authors in greater detail with the following results. The acid, $C_6H_4N(CO_2H)_3$, obtained by oxidising corydaline (*Trans.*, 1897, 71, 657), is, by long-continued heating with potassium permanganate in alkaline solution, converted into 2 : 3 : 4 : 6-pyridinetetracarboxylic acid. The acid, $C_6H_4N(CO_2H)_3$, must therefore either be 2—CH_3 3 : 4 : 6-pyridinetricarboxylic acid or 2—CH_3 4 : 5 : 6-pyridinetricarboxylic acid. From what follows, the former formula is probably the correct one.

Corydilic acid, $C_{12}H_6N(OCH_3)_2(CO_2H)_3$ (*Trans.*, 1897, 71, 657), is soluble in hydrochloric acid and under certain conditions forms an unstable hydrochloride. When boiled with potassium permanganate, it is split up into a mixture of meta-hemipinic acid and the acid $C_6H_4N(CO_2H)_3$.

When corydic acid (*Trans.*, 1897, 71, 657), $C_{14}H_9N(OCH_3)_2(CO_2H)_2$, is oxidised with permanganate at the ordinary temperature, it yields a yellow, dibasic acid, $C_{12}H_9N(OCH_3)_2(CO_2H)_2$, which contains the two methoxyl groups of corydic acid.

Mild oxidising agents remove four atoms of hydrogen from corydaline and convert it into dehydrocorydaline, an intensely yellow coloured base (*Trans.*, 1897, 71, 657). Berberine is also a yellow coloured base, but readily takes up four atoms of hydrogen, forming colourless tetrahydroberberine. Corydaline therefore corresponds to tetrahydroberberine and dehydrocorydaline to berberine.

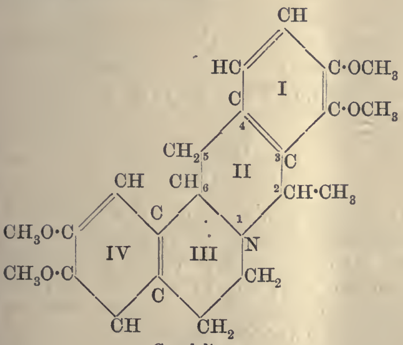
Corydaline (colourless). $C_{22}H_{27}NO_4$.	Tetrahydroberberine (colourless). $C_{20}H_{21}NO_4$.
Dehydrocorydaline (yellow). $C_{22}H_{23}NO_4$.	Berberine (yellow). $C_{20}H_{17}NO_4$.

The four oxygen atoms of corydaline are all present in methoxyl groups (*Trans.*, 1892, 61, 605). When oxidised with potassium permanganate at 100°, corydaline yields a mixture of hemipinic and metahemipinic acids, together with corydaldine, $C_{11}H_{13}NO_3$, a neutral substance of which the yield is larger when the oxidation takes place at the ordinary temperature. This substance has been shown to be an *iso*quinoline derivative.

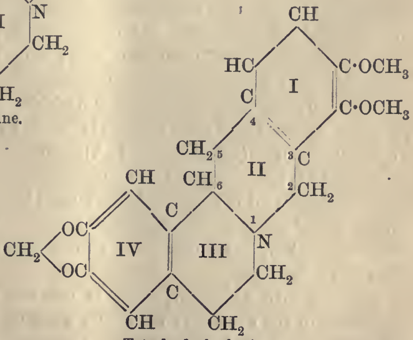
When oxidised with dilute nitric acid, corydaline, $C_{22}H_{27}NO_4$, is first converted into dehydrocorydaline, $C_{22}H_{23}NO_4$; further oxidation splits off one of the benzene rings and yields corydic acid, a yellow, crystalline substance (*Trans.*, 1897, 71, 657). Corydic acid in turn, when oxidised at 100° with permanganate, yields meta-hemipinic acid, the acid $C_6H_4N(CO_2H)_3$, and the highly insoluble, colourless corydilic acid, $C_{12}H_6N(OCH_3)_2(CO_2H)_3$, which, on further oxidation with permanganate, is entirely resolved into meta-hemipinic acid and the acid $C_6H_4N(CO_2H)_3$.

As the acid $C_6H_4N(CO_2H)_3$ contains six atoms of carbon in addition to the carbon atoms of the carboxyl groups, it cannot be derived from the *iso*quinoline nucleus which has no methyl group attached to it, but must represent a fourth ring, and the nitrogen atom must, as in the case of berberine, be common to two rings.

There are thus four rings in corydaline. The following formula satisfactorily explains the formation of all the derivatives of corydaline which have been examined.

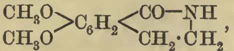


Corydaline.

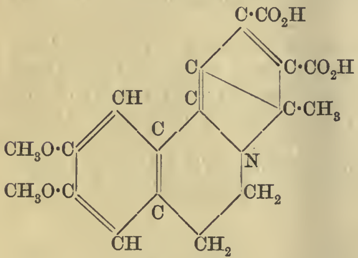


Tetrahydroberberine.

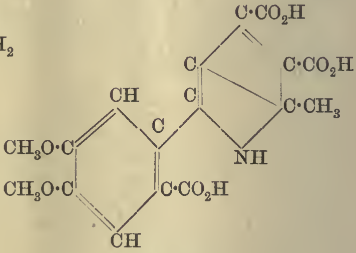
By oxidation, rings I and IV would yield hemipinic and meta-hemipinic acids respectively; ring II, the acid $C_6H_4N(CO_2H)_3$. Corydaldine,



$\begin{matrix}CH_3O\\CH_3O\end{matrix}>C_6H_2<\begin{matrix}CO-NH\\CH_2\cdot CH_2\end{matrix}$, contains rings III and IV, and would result from the oxidation of corydaline, just as ω-amidoethylpiperonylcarboxylic anhydride results from the oxidation of berberine. Corydic acid would be formed by the destruction of ring I, and corydilic acid from corydic acid by the oxidation of ring III. The formulæ of the last-mentioned acids are therefore:



Corydic acid.



Corydilic acid.

A comparison between the formulæ of corydaline and tetrahydroberberine explains the resemblance between the two substances and their oxidation products. By oxidation, ring I, both in berberine and corydaline, yields hemipinic acid; ring IV in berberine yields hydrastic acid, corresponding to meta-hemipinic acid from corydaline. ω-Amidoethylpiperonylcarboxylic anhydride, corresponding to corydaldine, is derived from rings III and IV, and berberonic acid, $C_5H_2N(CO_2H)_3$ $[(CO_2H)_3 = 3:4:6]$, corresponding to the acid $C_6H_4N(CO_2H)_3$, from ring II in corydaline.

Berberonic acid is derived from ring II, and not from ring III, which would yield carbocinchomeronic acid. This point is not dealt with by Perkin, but incidentally affords confirmation of the correctness of his formula.

The ease with which corydaline is oxidised to dehydrocorydaline is explained in the same way as in the case of the oxidation of tetrahydroberberine to berberine, the hydrogen atoms attached to the carbon atoms 2, 5, and 6 of ring II being removed on oxidation, and a link established between the atoms 2 and 5, and a second link between 5 and 6.

The above formula for corydaline, which accounts for its decomposition products and explains the analogies with berberine, involves the adoption of the constitution $2-CH_3 : 3 : 4 : 6$ for the acid $C_6H_4N(CO_2H)_3$; the alternative formula would leave the resemblance to berberine unexplained.

*172. "The relation of corydaline to berberine; the oxidation of berberine with nitric acid." By J. J. Dobbie, D.Sc., M.A., and A. Lauder, B.Sc.

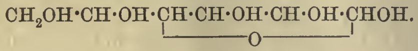
In the previous abstract it is shown that the constitution of corydaline can be expressed by a formula similar to one of the formulæ proposed by Perkin for berberine.

Assuming the correctness of the formula for corydaline, the absence of compounds corresponding to berberal and berberilic acid (Perkin, *Trans.*, 1890, 57, 992) from amongst the decomposition products of corydaline is explained, since all these substances contain an atom of oxygen united to the carbon atom 2 in ring II (see previous abstract), where owing to the presence of the methyl group it is impossible to introduce an oxygen atom into corydaline derivatives. If the view of the relation of the two substances expressed in the formulæ is correct, the first of Perkin's alternative formulæ (Perkin, *Trans.*, 1890, 57, 992) must be adopted. In his second formula, a double bond is shown between the carbon atoms 2 and 5 of ring II. No double bond in this position is possible in dehydrocorydaline on account of the presence of the methyl group, and the analogy between the two substances breaks down if we suppose the double bond in ring II to occupy different positions. Whilst the absence of certain decomposition products is thus satisfactorily accounted for, the formation of corydic acid from corydaline suggests the possible formation of a similar acid from berberine. By oxidising berberine with dilute nitric acid in exactly the same way as was followed in the preparation of corydic acid (*Trans.*, 1897, 71, 657), an acid, $C_{16}H_{11}NO_6$ (m. p. 285°), was obtained closely resembling corydic acid in properties and obviously bearing to berberine the same relation as corydic acid to corydaline. This acid is very difficultly soluble in hot water; it dissolves in sodium hydroxide, forming a blood-red solution. It is dibasic, almost all its salts are soluble, a notable exception being the acid silver salt. It contains no methoxyl groups, hence (as in the case of corydaline) it is formed by the destruction of ring I. By oxidation with potassium permanganate, it yields berberonic acid, $C_5H_2N(CO_2H)_3$ $[(CO_2H)_3 = 3:4:6]$, and ω-amidoethylpiperonylcarboxylic anhydride. The name *berberidic* is proposed for this new acid.

*173. "The magnetic rotation of some polyhydric alcohols, hexoses and disaccharoses." By W. H. Perkin, sen., Ph.D., F.R.S.

The object of this investigation was to see if any clue could be obtained from the magnetic rotation of the sugars as to the cause of their bi- or multi-rotation. Some of the polyhydric alcohols were also examined in order that data might be obtained from which to calculate the probable values for the various sugars.

From the rotations obtained for glucose and for fructose, it was found that the suggestion that bi-rotation was due to hydration was untenable. The magnetic rotations are too low for substances possessing the aldehydic and ketonic constitutions usually assigned to these sugars, but they correspond with substances containing an oxygen atom linked as in ethylene oxide or the lactones, all of which give low numbers. This agrees with the suggestion of Lowry (*Trans.*, 1899, **75**, 215), that when in solution and having undergone the largest amount of change, glucose exists chiefly in an isomeric form for which he gave two formulæ, of which the more probable one, judging from the magnetic rotation, may be represented thus,



$$CH_2OH\cdot CH\cdot OH\cdot\underbrace{CH\cdot CH\cdot OH\cdot CH\cdot OH\cdot CH}_{O}OH.$$

This is the formula originally proposed by Tollens for dry glucose (*Ber.*, 1883, **16**, 92). When slightly modified it can also be used to represent fructose in an isomeric condition, equally consistent with the magnetic rotation of this substance in solution.

Saccharose may be regarded as built up from glucose and fructose, both being in their isomeric forms, with elimination of water, its constitution being that proposed by E. Fischer (*Ber.*, 1893, **26**, 2405), which is a slight modification of that suggested by Tollens (*Ber.*, 1883, **16**, 923).

Maltose and lactose, which possess both birotation and reducing power, appear to have analogous structures, the formula proposed by Fischer for lactose (*loc. cit.*) being practically applicable to both, but their constitution is different from that of saccharose. Hence maltose and lactose are formed from a molecule of glucose or of galactose in the isomeric condition, *plus* a molecule of glucose in the ordinary or aldehydic form, *minus* water, the aldehydic part undergoing isomeric change to a greater or less extent when these disaccharoses are dissolved in water; in this way the possession of birotation by these substances may be explained.

*174. "Stereoisomeric halogen derivatives of α-benzoylcamphor." By M. O. Forster and Miss F. M. G. Micklethwait.

α′-Benzoyl-α-bromocamphor, $C_8H_{14}<\begin{matrix}CBr\cdot CO\cdot C_6H_5\\ |\\ CO\end{matrix}$, prepared by dissolving 1-hydroxy-2-benzoylcamphene in glacial acetic acid containing sodium acetate (1½ mols.) and adding a solution of bromine (1 mol.) in acetic acid, crystallises from light petroleum in large, transparent, six-sided prisms and melts at 114°; dissolved in benzene it has $[\alpha]_D = -10{\cdot}0°$, and in chloroform $[\alpha]_D = +10{\cdot}3°$.

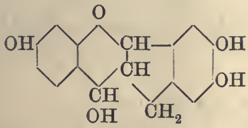
α-Benzoyl-α′-bromocamphor is formed in preponderating amount when potassium hypobromite acts on hydroxybenzoylcamphene dissolved in potash; it crystallises from hot alcohol in transparent, rectangular plates melting at 214°, and has $[\alpha]_D = -53{\cdot}2°$ in benzene and $[\alpha]_D = -19{\cdot}3°$ in chloroform. Hydrogen bromide converts the low melting isomeride into the less readily fusible modification.

α′-Benzoyl-α-chlorocamphor, $C_8H_{14}<\begin{matrix}CCl\cdot CO\cdot C_6H_5\\ |\\ CO\end{matrix}$, obtained by the action of sodium hypochlorite on hydroxybenzoylcamphene, melts at 88°, and has $[\alpha]_D = -27{\cdot}9°$ in chloroform.

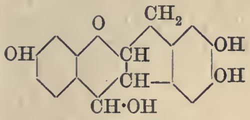
α-Benzoyl-α′-chlorocamphor is produced in the same way and separated by means of its sparing solubility in alcohol; it melts at 219° and has $[\alpha]_D = +26{\cdot}2°$ in chloroform.

*175. "Brasilin and hæmatoxylin. Part VI. The constitution of brasilic acid, of brasilin and of hæmatoxylin." By W. H. Perkin, jun.

In part I of this research (A. W. Gilbody, W. H. Perkin, jun., and J. Yates, *Trans.*, 1901, 79, 1401), it was argued that since trimethylbrasilin on oxidation with permanganate yields 2-carboxy-5-methoxyphenoxyacetic acid and meta-hemipinic acid, the constitution of brasilin must be represented by one of the following formulæ:



I.



II.

In order to decide between these two formulæ, the author has submitted brasilic acid to a detailed examination and has obtained results which show clearly that formula I must be accepted as representing the constitution of brasilin.

Brasilic acid, $C_{12}H_{12}O_6$, is produced by the oxidation of trimethylbrasilin with permanganate, but the yield is only 0·7 per cent.; it is a monobasic acid, the *silver* salt having the formula $C_{12}H_{11}AgO_6$. The sodium salt, $C_{12}H_{11}NaO_6$, is comparatively sparingly soluble and crystallises in glistening plates.

Since brasilic acid contains one methoxyl group, its formula may be written $MeO{\cdot}C_{10}H_8O_3{\cdot}CO_2H$, and as on fusion with potash it yields a substance which with ferric chloride gives a violet coloration, it is evidently derived from the resorcyl nucleus of brasilin. Furthermore, it yields an oily oxime, $MeO{\cdot}C_9H_8O_2(C{:}NOH)CO_2H$, and when reduced with sodium amalgam it is converted into the *lactone* of *dihydrobrasilic acid*, $C_{12}H_{12}O_5$, which melts at 144° and is very sparingly soluble in ether.

From this behaviour, it follows that brasilic acid contains a carbonyl group, and that this is probably in the γ-position in relation to the carboxyl group.

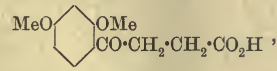
When warmed with sulphuric acid, brasilic acid loses one molecule of water and is converted into *dehydrobrasilic acid*, $C_{12}H_{10}O_5$, a monobasic acid, which is very sparingly soluble in water, melts at 197°, and when treated with permanganate in the cold is oxidised with formation of *p*-methoxysalicylic acid, $MeO{\cdot}C_6H_3(OH){\cdot}CO_2H$.

Hydroxylamine converts dehydrobrasilic acid into an oxime, $C_{12}H_{11}NO_5$, which melts at 172°. The acid, therefore, still contains a carbonyl group. When digested with baryta water, it is readily decomposed with formation of formic acid and a new acid, $C_{11}H_{12}O_5$.

$$C_{12}H_{10}O_5 + 2H_2O = H{\cdot}CO_2H + C_{11}H_{12}O_5.$$

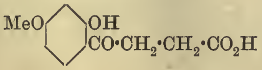
This new acid crystallises from water in colourless needles, melts at 155° and gives, in aqueous solution, an intense violet coloration with ferric chloride; when heated with sodium methoxide and methyl iodide it yields a methyl derivative, $C_{12}H_{14}O_5$, which melts at 147°.

In conjunction with Mr. E. Ormerod, the author has succeeded in synthesising this latter by treating dimethylresorcinol in the presence of aluminium chloride with the ester of the half-chloride of succinic acid, $COCl{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et$, the methyl derivative, $C_{12}H_{14}O_5$, must therefore be 2 : 4-dimethoxybenzoylbutyric acid,



,

and the acid, $C_{11}H_{12}O_5$, from which it is derived by methylation, is 2-hydroxy-4-methoxybenzoylbutyric acid,



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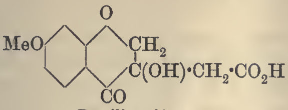
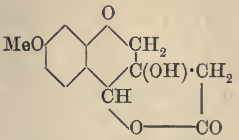
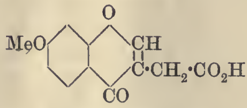
The constitutions of the other acids mentioned above are now established, and are as follows :



Brasilic acid.



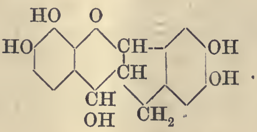
Lactone of dihydrobrasilic acid.



Dehydrobrasilic acid.

Since, of the two formulæ for brasilin given above, formula I alone accounts, in a simple manner, for the formation of brasilic acid, it appears to the author that this must be accepted as representing the constitution of brasilin.

It has already been shown (*Proc.*, 1900, 16, 107) that tetramethylhæmatoxylin, on oxidation with permanganate, gives products which are exactly similar to those obtained from trimethylbrasilin, and there can, therefore, scarcely be a doubt that the constitutional formula of hæmatoxylin is



176. "Is argon an elementary substance ?" By G. Martin.

Some eighty distinct elementary substances are now recognised. These are assumed to be composed of different kinds of matter because each one has *chemical properties* peculiar to itself alone. Physical properties are of little value in deciding whether different substances are merely allotropic modifications of one kind of elementary matter, or whether they are distinct elements. The only certain test lies in the *chemical nature* of the compounds produced when the elements unite with other elements.

Elements often resemble each other so strongly in their physical nature that it is almost impossible to distinguish between them. For example, the new radio-active elements are so similar to bismuth, barium and titanium, that many chemists still hesitate to believe them elementary. The rare earths are composed of elements so much alike that it is with the utmost difficulty they can be distinguished from one another.

But all these substances have one characteristic which stamps them as elements—*each produces its own peculiar set of compounds.* This characteristic is absent from argon and its companions; therefore, in order to demonstrate their elementary nature, Ramsay had to fall back on their physical properties—the most untrustworthy of all methods.

These properties stamp the new gases as a distinct class of elements; but they do not, and cannot, prove that each "element" is a single substance and not a *group* of closely related elements. For instance, were *argon* a *mixture* of 3 monatomic gases of like nature, and of which the atomic weights differed from each other by a fraction of a unit—as do those of nickel and cobalt—it would be impossible to distinguish the mixture from an element. It would answer to exactly the same physical tests and could not be resolved into its compounds by any *physical methods* except with the utmost difficulty. It takes many thousands of fractionations to distinguish between two rare earths, which not only give different chemical compounds, but are far more unlike chemically than would be 3 *monatomic inert gases.*

We are peculiarly liable in the eighth group to meet with neighbouring elements of almost identical atomic weight and properties. For instance, in series 4 of the periodic table, as we advance with increasing atomic weight from potassium to nickel, the resemblance between successive elements steadily increases; potassium and calcium, for example, are quite unlike each other, but vanadium, chromium, manganese, and iron are all strikingly analogous, while the two last elements of the series, cobalt and nickel, have almost identical atomic weights and resemble each other in a most remarkable degree.

In many of the other series, also, we end up in the eighth group with elements so very similar that they are classed as "triads," for example, ruthenium, rhodium, and palladium; osmium, iridium, and platinum; the atomic weights of these triads are in every case very close together.

If each of the "elements" of Ramsay really consists of three allied substances, the eighth group of the periodic table would lose altogether its peculiar "triad" character and split up into three distinct groups—a possibility which of late years has been running through many minds.

177. "The action of phosphorus trithiocyanate on alcohol."

By Augustus Edward Dixon, M.D.

Lössner states in a brief preliminary note (*J. prakt. Chem.*, 1873, ii, 7, 474) that phosphorus trichloride, acting upon an alcoholic solution of potassium thiocyanate, produces a substance crystallising in fin needles, and having the formula $C_8H_{18}N_4S_4O$.

From results obtained by the author in his study of phosphorous and phosphoryl 'thiocyanates,' recently commenced (*Trans.*, 1901, 79, 541), it seemed probable that Lössner's compound, if really formed, must have originated through some decomposition of the phosphorus trithiotriurethane, $P(NH{\cdot}CS{\cdot}OEt)_3$, which might be expected to result from the union of phosphorus trithiocyanate, $P(SCN)_3$, or $P(NCS)_3$, with the alcohol used as solvent; to ascertain if this was the case, the two latter substances were caused to interact directly, in presence of dry benzene.

Phosphorus trithiotriurethane could not be identified; neither could Lössner's compound: thiocyanic acid was expelled, and the residual liquid was eventually resolved into (1) an acid oil, containing phosphorus, and (2) *iso*persulphocyanic acid.

Phosphorus trichloride interacted violently with alcoholic potassium thiocyanate: potassium chloride was precipitated, thiocyanic acid is given off, and from the residual oily liquid, after concentration, *iso*persulphocyanic acid was deposited: no sign could be got of the presence of the compound $C_8H_{18}N_4S_4O$.

The author supposes the *iso*persulphocyanic acid, which is formed in small relative amount in either process, to be produced through the interaction of the mineral acid with the thiocyanic acid simultaneously liberated.

Benzyl alcohol interacts spontaneously with phosphorus trithiocyanate, but, as in the case of ethyl alcohol, no evidence could be obtained of the existence of a salt of phosphorus trithiotricarbamic acid, $P(NH{\cdot}CS{\cdot}OH)_3$; if such compounds are formed at all in these interactions, it is probable that, like their congeners of the thiocarbamidic class, they very readily undergo hydrolysis.

178. "The influence of salts and other substances on the vapour pressure of aqueous ammonia solution." By E. P. Perman.

The author has investigated the effect produced by urea, mannite, potassium sulphate, ammonium chloride, and copper sulphate respectively on the vapour pressure of aqueous ammonia solution by a method similar to that described for sodium sulphate (*Trans.*, 1901, 79, 725). The objects of the research were to find (1) the effect upon the pressure of substances which have no direct chemical action on the ammonia, (2) the effect of rise of temperature on copper sulphate ammonia solution, (3) evidence for or against the existence of hydrates in solution.

The conclusions arrived at by the author are: (1) that salts of the alkalis have a great effect in raising the pressure, but that the effect of other substances which might be expected to have no direct chemical action on the ammonia is either small or nothing.

(2) That copper sulphate forms complexes with ammonia in solution which tend to decompose on heating, especially when the proportion of copper sulphate is small.

(3) The effect of potassium sulphate is similar to that of sodium sulphate in raising the pressure. There is but little reason to suspect the existence of a hydrate of potassium sulphate, as it crystallises without water; consequently it would appear that neither sulphate exists in solution as a hydrate.

179. "The action of sodium hypochlorite on benzenesulphonanilide. Preliminary notice." By J. B. Cohen and J. T. Thompson.

In the preparation of the different isomeric dichlorotoluenes (Cohen and Dakin, *Trans.*, 1901, **79**, 1111), the authors had frequent recourse to the method of chlorination recently studied by Chattaway and Orton (*Trans.*, 1899, **75**, 1046; 1900, **77**, 134 and 789, and *Ber.*, 1899, **32**, 3573). The authors have found that a very similar reaction occurs with the aromatic sulphonanilides, of which, with Dr. Chattaway's friendly acquiescence, the authors now give a brief notice. Twenty grams of benzenesulphonanilide were dissolved in 200 c.c. of a solution of sodium hypochlorite (1 c.c. = 0·03 gram Cl) in the cold and allowed to stand 12 hours. The brown solution was acidified with acetic acid until the buff precipitate redissolved, when it was extracted with chloroform. After rapidly evaporating off the solvent, the residual red liquid was digested for an hour with two volumes of glacial acetic acid containing a few drops of concentrated sulphuric acid, until, on pouring into water, a solid substance separated. The new compound was recrystallised from acetic acid and then from alcohol, when it melted at 129—130°. The yield amounted to 18 grams of crude or 11 grams of purified substance.

The mother liquor contained a small quantity of a semi-solid substance, which became crystalline on standing and after recrystallisation from benzene and petroleum melted at 116°. This substance is probably the benzenesulphonyl-*p*-chloranilide (m. p. 121°), but it is difficult to free it from oily impurity. The substance melting at 129—130° was analysed, with the following result:

0·292 gave 14·15 c.c. moist nitrogen at 15·5° and 758 mm. N = 5·66.
0·3185 „ 0·1764 AgCl. Cl = 13·57.
0·2097 „ 0·1820 $BaSO_4$. S = 11·93.
$C_{12}H_{10}O_2NSCl$ requires N = 5·23; Cl = 13·27; S = 11·90.

In order to determine the constitution of the substance, it was hydrolysed. Two grams were heated with about eight grams of concentrated hydrochloric acid in a sealed tube to 190° for 4—5 hours. On opening the tube, there was a strong smell of benzene, the presence of which was confirmed by extracting with light petroleum, nitrating the extract with a mixture of concentrated sulphuric and nitric acids, washing, and evaporating off the light petroleum. On reducing the residue with zinc dust and acetic acid, aniline was formed and gave an intense violet coloration with sodium hypochlorite solution. The appearance of benzene in the decomposition of the sulphonanilide compound is readily accounted for, seeing that Armstrong and Field (*Ber.*, 1874, 7, 406) and Jacobsen (*Ber.*, 1876, 9, 258) have shown that sulphonic acids are converted into the hydrocarbons by strong hydrochloric acid under pressure. The acid solution, after extracting with light petroleum, was made alkaline with sodium carbonate and distilled in steam. The distillate was extracted with ether, the ether removed, and the residue dehydrated in vacuo. A yellow oil weighing 0·8 gram remained. The substance did not solidify on introducing a crystal of *p*-chloraniline, even when cooled in ice; it yielded an acetyl derivative melting at 85—86° and a benzoyl derivative melting at 102°. This corresponds to *o*-chloraniline which was prepared from *o*-nitraniline, and then converted into the acetyl and benzoyl derivatives having the above melting points. In further confirmation, the *o*-chloraniline was heated with benzenesulphonic chloride and converted into the sulphonanilide melting at 129—130°, which agrees with the melting point of the product obtained by the action of sodium hypochlorite on benzenesulphonanilide. The reaction, therefore, probably occurs in two steps, as in the chlorination of the acetyl derivatives studied by Chattaway and Orton,

$$C_6H_5SO_2NHC_6H_5 + Cl_2 = C_6H_5SO_2{\cdot}NCl{\cdot}C_6H_5 + HCl,$$
$$C_6H_5SO_2{\cdot}NCl{\cdot}C_6H_5 = C_6H_5SO_2{\cdot}NH{\cdot}C_6H_4Cl,$$

with the formation mainly of benzenesulphonyl-*o*-chloranilide and a small quantity of the *p*-chloranilide.

Wallach (*Ber.*, 1877, 9, 424) found that benzenesulphonanilide, when heated to 100° with phosphorus pentachloride, yields benzenesulphonyl *p*-chloranilide, m. p. 121°; but no reference is made to an *o*-compound. The authors have repeated Wallach's work, which they can confirm. The product is difficult to purify and only a small yield of pure substance could be obtained. From *p*-chloraniline and benzene sulphonic chloride the authors have also synthesised this substance, which melts at 121° as stated by Wallach.

To complete the series, the authors have synthesised the benzene sulphonyl-*m*-chloranilide from *m*-chloraniline, which has not been previously described; like the *p*-compound, it melts at 121°. It gave the following result on analysis:

0·2576 gave 12·85 c.c. moist nitrogen at 13° and 741 mm. N = 5·76.
$C_{12}H_{10}O_2NSCl$ requires N = 5·23 per cent.

The authors intend to continue the investigation.

180. "The relationship between the substitution and the constitution of benzeneazo-α-naphthol." By J. T. Hewitt and S. J. M. Auld.

Möhlau and Kegel (*Ber.*, 1900, **33**, 2858) have shown that benzeneazo-α-naphthol reacts with Michler's hydrol (tetramethyldiaminobenzhydrol) to form a condensation product in the same manner as paraquinones and their derivatives. Moreover, the substance obtained acetylates in such a manner that the entering acetyl group attaches itself to a nitrogen atom. The authors mentioned draw the conclusion that benzeneazo-α-naphthol and its derivatives are of quinone-hydrazone type.

The results obtained by the authors of the present communication are in favour of an oxyazo-formula. Benzeneazo-α-naphthyl acetate yields aniline on complete fission and no acetanilide. By partial reduction, a hydrazo-compound is obtained melting about 160—165°; the formula $C_6H_5\cdot NH\cdot NH\cdot C_{10}H_6\cdot O\cdot COCH_3$ is confirmed by the insolubility of the substance in dilute alkalis.

Nitric acid is not a satisfactory substituting agent to use with benzeneazo-α-naphthol, but bromine reacts with the azonaphthol in presence of acetic acid and sodium acetate, forming a *monobromo*-derivative of m. p. 196°. This substance yields aniline on fission, the bromine therefore enters the naphthol nucleus. From this benzeneazobromonaphthol the *ethyl ether*, m. p. 220° (uncorr.), and *acetyl* derivative, m. p. 146°, have been prepared.

The following substances containing bromine in the benzene nucleus have been prepared for purposes of comparison.

o-*Bromobenzeneazo-α-naphthol*, m. p. 183°. o-*Bromobenzeneazo-α-naphthyl acetate*, m. p. 123°. m-*Bromobenzeneazo-α-naphthol*, m. p. 211° (uncorr.). m-*Bromobenzeneazo-α-naphthyl acetate*, m. p. 112°. *p*-Bromobenzeneazo-α-naphthol, m. p. 237—238° (Bamberger, *Ber.*, 1895, **28**, 1896). p-*Bromobenzeneazo-α-naphthyl acetate*, m. p. 141°.

The bromination of benzeneazo-β-naphthol is now being studied.

ADDENDUM TO DISCUSSION

On Messrs. Hall and Plymen's paper, No. 162, on "The determination of available plant food in soils by the use of dilute solvents."

DR. DYER pointed out that any process must necessarily be empirical. The actions of the root sap of plants could not be exactly imitated and much must always depend, not only upon the composition of the solution used, but also upon its volume and the duration of contact. He was very glad that the 1 per cent. citric acid solution had on the whole given more reliable indications of the degree of comparative fertility as regarded both phosphoric acid and potash than did the other acid solutions tried. When he was in America a year ago, he found in use for the determination of "available" phosphoric acid a one-fifth normal solution of hydrochloric acid, but this did not give satisfactory results for potash and he understood that at that time they had not decided in America what was the best solution to use for potash. As to the limits which he had laid down as indicating need of manurial phosphoric acid or potash, both in his original paper on the Hoos Field soils and in a paper on the Broadbalk soils (*Phil. Trans.*, 1901, **194**B., 235), he had pointed out that the limits which he gave related to cereal crops and might probably have to be modified with reference to root and other crops. In this direction, much more work was required. Dr. Dyer called attention to some experiments recently carried out by Mr. Ingle of the Yorkshire College, Leeds, in which he had extracted a large quantity of soil with 1 per cent. citric acid solution, and after washing out had grown various crops in it in pot-culture, with and without total or partial replacement of the constituents removed. Some of Mr. Ingle's photographs were exhibited, which showed that the soil when exhausted of its "available" constituents by 1 per cent. citric acid solution, was hardly able to support the life of bean plants, but that when the constituents thus dissolved out were replaced the plants flourished abundantly. Mr. Ingle's experiments were not yet completed, but so far they appeared to confirm the practical value of 1 per cent. citric acid solution as a reagent in soil analysis.

Dr. J. A. VOELCKER remarked that the experiments of the authors had shown very clearly the influence of one constituent of the soil upon another. Mr. Hall had himself pointed out the variations caused by the presence or absence of lime, and Dr. Dyer had shown how the action of citric acid was influenced by the presence of sodium and magnesium salts, and how irregular were the results when farmyard manure had been applied to the land. He did not think it was right to take one particular solvent and of one particular strength, and to apply it indiscriminately to all classes of soils alike, nor did he think that the use of hydrochloric acid should be abandoned on the grounds given. That a 1 per cent. solution showed, with certain soils, results not consistent with those of certain other solvents or with those of a strong solution of the acid afforded no proof that the acid was an unsuitable solvent. In work on which he had lately been engaged, he had found a 1 per cent. citric acid solution useful in many cases, and it was certainly an advance on the older methods, but he was not altogether satisfied with it as yet, and had not found the results to be in all cases consistent with the conclusions arrived at from practical experience of the land. It was not improbable that a distinction would have to be drawn between the two different classes of phosphoric acid present in the soil, the one the phosphoric acid naturally belonging to the soil, the other the phosphoric acid accumulated by repeated manurial applications.

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Ryn, J. L. van. The Composition of Dutch Butter. Pp. 55. London. 1902. From the Publishers.

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Wallach, O. Briefwechsel zwischen J. Berzelius u. F. Wöhler im Auftrage der K. Gessell. d. Wissen. zu. Göttingen, mit einem Commentar von J. von Braun. Erster Band, mit Berzelius' Bildnis. Zweiter Band, mit Wöhlers Bildnis. 8vo, pp. 717, 744. Leipzig 1901.

III. Pamphlets.

Batschinski, Alexius. Studien zur Kenntnis der Abhängigkeit der Viscosität der flüssigen Körper von der Temperatur u. von ihrer chemischen Constitution. Abt. I. Moscow. 1901. From the Author.

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OF

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£10 to J. J. Sudborough, for the continuation of an investigation of the esterification constants of certain organic acids, and of the derivatives of trinitrobenzene.

£10 to A. R. Ling and B. F. Davis, for an investigation of the action of diastase on starch.

£25 to W. J. Pope, for the continuation of his investigation of organo-tin compounds, for the preparation of substances containing asymmetric phosphorus and selenium atoms, and for the general extension of our knowledge of optical activity.

£10 to G. D. Lander, for an investigation of the imino-ethers and allied compounds.

£15 to A. Lapworth, for an investigation of isomeric change and allied phenomena.

£15 to A. McKenzie, for an investigation of fractional esterification and the hydrolysis of isomerides.

£10 to W. H. Mills, for the continuation of an investigation of the synthesis of hydrocarbons.

£20 to R. H. Pickard, for an investigation of the constitution of cholesterol.

£20 to James Walker, for an investigation of tetra-alkylammonium hydroxides.

£20 to A. W. Crossley, for the continuation of his investigation of the action of phosphorus haloids on substituted dihydroxyresorcinols.

£10 to Miss I. Smedley, for an investigation of the colour of iodine-containing compounds.

£20 to A. G. Perkin, for the continuation of his investigation of natural colouring matters.

LIST OF FELLOWS ELECTED DURING 1902.

Name.	Proposed.	Elected.
Alder, John Frederick	November 6th, 1902	December 4th.
Ashe, James Samuel	March 6th, 1902	April 30th.
Baker, Frederick G. S.	February 6th, 1902	April 30th.
Ball, James H.	May 15th, 1902	June 18th.
Beanes, Alfred Edward	November 6th, 1902	December 4th.
Benham, Keith Benham	December 19th, 1901	February 19th.
Bergtheil, Cyril	February 19th, 1902	April 30th.
Black, Walter Geoffrey	November 21st, 1901	February 19th.
Blair, Herbert	November 6th, 1902	December 4th.
Blenkinsop, Richard	February 6th, 1902	April 30th.
Boardman, Ernest	February 19th, 1902	,, ,,
Brincker, John A. H.	November 6th, 1902	December 4th.
Bruce, Alexander	February 6th, 1902	April 30th.
Bryant, Vernon Seymour	November 6th, 1902	December 4th.
Bucknell, Edwin Thomas H.	May 28th, 1902	June 18th.
Burrows, Harry	December 5th, 1901	February 19th.
Burt, Bryce Chudleigh	May 15th, 1902	June 18th.
Buxy, Tarit Kanti	February 6th, 1902	February 19th.
Carmichael, Thomas Burnell	November 6th, 1902	December 4th.
Carrodus, Fred	February 6th, 1902	April 30th.
Catchpole, Frederick E.	November 21st, 1901	February 19th.
Challen, Matthew Bradbury	January 16th, 1902	,, ,,
Chance, Kenneth Macomb	December 5th, 1901	,, ,,
Claudet, Arthur Crozier	May 15th, 1902	June 18th.
Clifford, William	December 5th, 1901	February 19th.
Clough, William Thomas	April 17th, 1902	June 18th.
Clowes, George H. A.	March 19th, 1902	April 30th.
Cockle, Charles	November 6th, 1902	December 4th.
Cook, Arthur James	March 6th, 1902	April 30th.
Crocker, James Codrington	February 6th, 1902	,, ,,
Crookes, Henry	March 19th, 1902	,, ,,
Daniels, James Ward	November 21st, 1901	February 19th.
Davis, Charles Benson	February 19th, 1902	April 30th.
Davis, Frederick	November 21st, 1901	February 19th.
Davis, Henry Wilson	April 17th, 1902	June 18th.
De la Rue, Evelyn Andros	December 19th, 1901	February 19th.
Dennis, William	,, ,,	,, ,,
Dixon, John Kemp Smith	December 5th, 1901	,, ,,
Dobson, Henry Arthur	March 6th, 1902	April 30th.
Dorée, Charles	November 21st, 1901	February 19th.
Drought, James Justinian	November 6th, 1902	December 4th.
Edlin, Edgar Leeder	June 5th, 1902	December 4th.
Edminson, Sidney Robert	November 19th, 1902	,, ,,
Edwards, Walter Henry	November 6th, 1902	,, ,,
Elsden, Alfred Vincent	December 5th, 1901	February 19th.
Everitt, Walter	March, 19th, 1902	April 30th.
Eynon, Lewis	December 5th, 1901	February 19th.

Name.	Proposed.	Elected.
Fasnacht, Eugène A.	November 7th, 1901.	February 19th.
Ferrand, Frederick	December 5th, 1901.	,, ,,
Ferrier, John Oliver	,, ,,	,, ,,
Ferris, Percy J.	April 30th, 1902	June 18th.
Foll, Edgar W.	May 15th, 1902	,, ,,
Francis, Francis E.	May 28th, 1902	,, ,,
Garle, John Longsdon	May 15th, 1902	June 18th.
Gill, J. Arthur	March 19th, 1902	April 30th.
Gow, Alexander	April 30th, 1902	June 18th.
Green, Clarence J.	November 21st, 1901.	February 19th.
Green, George Felix D.	June 5th, 1902.	December 4th.
Griffiths, John T.	March 19th, 1902	April 30th.
Grimwade, Wilfrid Russell	November 6th, 1902.	December 4th.
Gumersall, Edward	,, ,,	,, ,,
Gunn, Gilbert	February 6th, 1902	April 30th.
Haas, Paul	December 19th, 1901.	February 19th.
Hallowell, Thomas B.	April 17th, 1902	June 18th.
Hann, Archie C. O.	April 30th, 1902	,, ,,
Harrison, Walter Ernest	,, ,,	,, ,,
Heaton, Noël	January 16th, 1902	February 19th.
Hennesey, Eugene E.	December 19th, 1901.	,, ,,
Holdcroft, George F.	December 5th, 1901.	,, ,,
Hollingworth, David V.	November 6th, 1902.	December 4th.
Holt, Alfred, jun.	,, ,,	,, ,,
Hopwood, Arthur	February 19th, 1902.	April 30th.
Hosking, Arthur Francis	June 5th, 1902.	December 4th.
Hurtley, W. H.	December 19th, 1901.	February 19th.
Jackson, Clements F. V.	November 6th, 1902.	December 4th.
Jackson, William Brannan	January 16th, 1902	February 19th.
Jardin, David S. Smith	December 19th, 1901.	,, ,,
Jardine, Douglas Kennedy	June 5th, 1902.	December 4th.
Kewley, James	March 6th, 1902	April 30th.
King, Francis E.	February 6th, 1902	,, ,,
King, Sidney I.	March 19th, 1902	,, ,,
Landau, A. Lionel	February 6th, 1902	April 30th.
Lavelle, Selwyn P. J.	January 16th, 1902	February 19th.
Leader, George H.	May 15th, 1902	June 18th.
Leather, John P.	November 6th, 1902.	December 4th.
Lessner, Charles B.	April 17th, 1902	June 18th.
Lidbury, Frank A.	November 6th, 1902.	December 4th.
Liotard, Ernest	,, ,,	,, ,,
Lockitt, Charles H.	February 6th, 1902	April 30th.
Logan, Thomas S.	November 6th, 1902.	December 4th.
Lucas, Harry	December 19th, 1901.	February 19th.
Ludlam, Ernest B.	November 21st, 1901.	,, ,,
MacCallum, Douglas A.	November 6th, 1902.	December 4th.
Mackenzie, John R.	December 19th, 1901.	February 19th.
Macknight, Alexander	March 6th, 1902	April 30th.
Maitland, William	December 19th, 1901.	February 19th.
Mann, William	November 6th, 1902.	December 4th.
Marsh, John	,, ,,	,, ,,

Name.	Proposed.	Elected.
Martin, Francis	December 19th, 1901.	February 19th.
Martindale, William H.	March 6th, 1902	April 30th.
Mathieson, Robert	March 19th, 1902	,, ,,
Mellor, Joseph W.	November 6th, 1902.	December 4th.
Mence, George A. H.	March 19th, 1902	April 30th.
Millington, John Price	November 6th, 1902.	December 4th.
Molesworth, Francis H.	December 19th, 1901.	February 19th.
Moody, James B.	May 15th, 1902	June 18th.
Moore, Thomas H.	April 17th, 1902	,, ,,
Mukerjee, Beni Madhav	November 19th, 1902.	December 4th.
Mundey, Alfred H.	December 19th, 1901.	February 19th.
O'Connor, Sinnott V.	April 30th, 1902	June 18th.
Ogilvie, Allan	January 16th, 1902	February 19th.
Panisset, Sydney G. S.	November 21st, 1901.	February 19th.
Peck, John W.	March 6th, 1902	April 30th.
Phelps, John	November 6th, 1902.	December 4th.
Phillips, Percy P.	May 15th, 1902	June 18th.
Pollitt, George P.	May 28th, 1902	,, ,,
Powney, William E. F.	May 15th, 1902	,, ,,
Přibram, Richard	November 19th, 1902.	December 4th.
Purtan, Herbert	June 5th, 1902.	June 18th.
Ralph, Stephen J.	April 30th, 1902	June 18th.
Ralphs, Edwin	,, ,,	,, ,,
Ramshaw, Walter	February 6th, 1902	April 30th.
Rây, Prafulla C.	April 17th, 1902	June 18th.
Revis, Cecil	February 6th, 1902	April 30th.
Ricketts, Guy D.	June 18th, 1902.	December 4th.
Roast, Harold J.	May 28th, 1902	June 18th.
Roberts, Jonathan H.	February 19th, 1902.	April 30th.
Ross, George A. P.	November 6th, 1902.	December 4th.
Ross, William C.	November 21st, 1901.	February 19th.
Sampson, John W.	November 6th, 1902.	December 4th.
Scholes, William	February 6th, 1902	April 30th.
Sidgwick, Nevil V.	January 16th, 1902	February 19th.
Simpson, Duncan	November 6th, 1902.	December 4th.
Sindall, Robert W.	,, ,,	,, ,,
Sinnatt, Frank S.	December 5th, 1901.	February 19th
Skertchly, William P.	April 17th, 1902	June 18th.
Smith, Leonard	June 5th, 1902.	December 4th
Smith, Robert E. B.	December 19th, 1901.	February 19th
Smythe, John S.	November 6th, 1902.	December 4th
Southworth, William	December 19th, 1901.	February 19th.
Stanger, William C. S.	May 15th, 1902	June 18th.
Stansfield, Edgar	June 18th, 1902.	December 4th.
Stead, Francis B.	November 21st, 1901.	February 19th.
Stewart, Hector	April 17th, 1902	June 18th.
Sutherst, Walter F.	November 6th, 1902.	December 4th.
Swain, James	January 16th, 1902	February 19th.
Taylor, Thomas	March 19th, 1902	April 30th.
Thomson, George S.	November 6th, 1902.	December 4th.
Tidy, Henry L.	November 6th, 1902.	,, ,,

Name.	Proposed.	Elected.
Tindall, Arthur L. B.	February 6th, 1902	April 30th.
Trimen, Stephen H.	February 19th, 1902	,, ,,
Tunnicliffe, William W.	February 19th, 1902	,, ,,
Turner, Lyon V.	December 5th, 1901	February 19th.
Wain, William C.	February 19th, 1902	April 30th.
Wallis, Thomas E.	June 18th, 1902.	December 4th.
Webb, Arthur J.	November 21st, 1901.	February 19th.
Wells, John W.	April 17th, 1902	June 18th.
West, Joseph	April 17th, 1902	,, ,,
Wheeler, Edward J.	May 28th, 1902	,, ,,
White, William C.	November 6th, 1902.	December 4th.
Wilkinson, Edward J.	February 6th, 1902	April 30th.
Wilson, Lyndon	November 6th, 1902.	December 4th.
Womersley, C. E.	November 21st, 1901.	February 19th.
Wood, Frank S.	March 19th, 1902	April 30th.
Young, Thomas A.	February 6th, 1902	,, ,,

FELLOWS DECEASED.

Name.	Elected.	Died.
Abel, Sir F. A.	March 21st, 1848	September 6th, 1902.
Aikman, C. M.	December 3rd,1885	November 14th, 1902.
Aquino, T. H.	March 4th, 1897	March 16th, 1902.
Blackett, C. R.	December 18th, 1879	October 18th, 1902.
Forsyth, W. C.	February 2nd, 1888	
Gee, T. E.	November 4th, 1875	June 27th, 1902.
Gladstone, J. H.	December 18th, 1848	October 6th, 1902.
Griffith, G.	June 16th, 1859	May 7th, 1902.
Hummel, J. J.	December 18th, 1879	September 13th, 1902.
Irvine, R	December 7th, 1871	March 20th, 1902.
Jackson, R.	December 6th, 1883	October 21st, 1902.
Macadam, W. I.	April 4th, 1878	June 24th, 1902.
Martindale, W.	April 7th, 1870	February 2nd, 1902.
Moore, Ira	March 6th, 1890	February 28th, 1902.
Moss, John	January 19th, 1871	September 2nd, 1902.
Pechmann, H. von	May 7th, 1896	March 19th, 1902.
Randall, W. B.	April 18th, 1843	March 14th, 1902.
Robbins, John	April 13th, 1872	August 8th, 1902.
Roberts-Austen, Sir W. C.	November 7th, 1866	November 22nd, 1902.
Sim, James	December 3rd, 1885	June 21st, 1902.
Simpson, Maxwell	December 16th, 1850	February 26th, 1902.
Thomas, Andrew	November 17th, 1859	December 9th, 1901.
Truman, E.	December 4th, 1873	October 31st, 1902.
Warmington, E. A.	June 15th, 1893	March 12th, 1902.
Wilson, G. F.	November 19th, 1855	March 28th, 1902.
Wislicenus, Johannes	February 2nd, 1888	December 6th, 1902.
Zingler, M.	April 4th, 1878	September 24th, 1902.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1902.

	Page in Proceedings.	Page in Transactions.
January 16*th.*		
1. An investigation of the radioactive emanation produced by thorium compounds. I. By E. Rutherford, M.A., D.Sc., and F. Soddy, B.A.	2	321
2. The constitution of hydrocyanic, cyanic, and cyanuric acids. By F. D. Chattaway and J. M. Wadmore	5	191
3. A modification of Zeisel's method for the estimation of methoxyl groups. By J. T. Hewitt and T. S. Moore	8	318
4. A new colour reaction of hydroxylamine. By W. C. Ball, B.A.	9	—
5. On the sensitiveness of a thermoregulator. By A. W. C. Menzies	10	—
6. Myricetin. Part II. By A. G. Perkin	11	203
7. The colouring matters of green ebony. By A. G. Perkin and S. H. C. Briggs	11	210
8. The action of methylene iodide on aryl- and naphthylamines: diarylmethylenediamines, acridines, and naphthacridines. By A. Senier and W. Goodwin	12	280
9 The polymerisation of cyanic acid: cyanuric acid and cyamelide. By A. Senier and T. Walsh	13	290
February 6*th.*		
10. Conversion of 1-hydroxycamphene into β-halogen derivatives of camphor. By M. O. Forster	25	264
11. The influence of temperature on association in benzene solution and the value of the molecular rise of boiling point for benzene at different temperatures. By W. R. Innes, M.Sc., Ph.D.	26	682
12. The magnetic rotation of ring compounds; camphor, limonene, carvene, pinene and some of their derivatives. By W. H. Perkin, sen., Ph.D., F.R.S.	28	292
13. The transport number of very dilute solutions. By B. D. Steele, B.Sc., and R. B. Denison, B.Sc.	29	456
14. An investigation into the composition of brittle platinum. By W. N. Hartley, D.Sc., F.R.S.	30	—
15. Tetrazoline. Part II. By S. Ruhemann and H. E. Stapleton	30	261
16. The solubilities of the calcium salts of the acids of the acetic acid series. By J. S. Lumsden, D.Sc., Ph.D.	31	350

	Page in Proceedings.	Page in Transactions.
17. The equilibrium between a solid and its saturated solution at various temperatures. By J. S. Lumsden, D.Sc., Ph.D.	31	363
18. On the union of hydrogen and chlorine. Part IV. The Draper effect. By J. W. Mellor and W. R. Anderson	32	414
19. Note on the constitution of certain organic nitrates. By C. R. Marshall and J. H. Wigner	32	—
20. Resolution of trimethylhydrindonium hydroxide into its optically active components. By F. S. Kipping...	33	275
21. Resolution of methylbenzylacetic acid into its optical isomerides. By F. S. Kipping	33	—
22. *d*-Methylhydrindone. The formation of oximes, hydrazones, and semicarbazones. By F. S. Kipping	34	—
23. Optically active methylbenzylacetic acid. By A. Lapworth and W. H. Lenton	35	—

February 19*th.*

24. The union of hydrogen and oxygen. By H. B. Baker	40	400
25. Enzyme action. By A. J. Brown	41	373
26. On the velocity of hydrolysis of starch by diastase with some remarks on enzyme action. By H. T. Brown and T. A. Glendinning	43	388
27. Polymerisation products from diazoacetic ester. By O. Silberrad, Ph.D.	44	598
28. Condensation of phenols with esters of unsaturated acids. Part VII. By S. Ruhemann	45	419
29. The chemical change produced by the immersion of lead in distilled water. By F. Clowes, D.Sc.	46	—
30. The bases contained in Scottish shale oil. Part I. By F. C. Garrett and J. A. Smythe	47	449
31. Note on "liquid nitrogen peroxide as a solvent." By P. F. Frankland, F.R.S., and R. C. Farmer, Ph.D..	47	—

March 6*th.*

32. The slow oxidation of methane at low temperatures. By W. A. Bone and R. V. Wheeler	51	535
33. Isomeric additive compounds of dibenzylketone and deoxybenzoin with benzal-*p*-toluidine, *m*-nitrobenzalaniline, and benzal-*m*-nitraniline. Part III. By F. E. Francis, B.Sc., Ph.D.	53	441
34. Mesoxalic semi-aldehyde. By H. J. H. Fenton, F.R.S., and J. H. Ryffel, B.A., B.Sc.	54	426
35. The action of hydrogen peroxide on carbohydrates in the presence of ferrous salts. III. By R. S. Morrell and J. M. Crofts	55	666
36. *m*-Nitrobenzoylcamphor. By M. O. Forster and Miss F. M. G. Micklethwait	55	406

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37. The Cloëz reaction. By F. D. Chattaway and J. M. Wadmore	56	—
38. The picrimidothiocarbonic esters. By J. C. Crocker, B.A.	57	436
39. Robinin, violaquercetin, myrticolorin and osyritrin. By A. G. Perkin	58	473
40. The nitration of *s*-trihalogen anilines. By K. J. P. Orton	58	490
41. Some *s*-nitrochlorobromoanilines and their derivatives. By K. J. P. Orton	59	495
42. The resolution of pheno-α-aminoheptamethylene into its optical isomerides. Tartrates of pheno-α-aminoheptamethylene and of hydrindamine. By F. S. Kipping and A. E. Hunter	60	574

March 19*th.*

43. Nitrogen chlorides containing the propionyl group. By F. D. Chattaway	64	637
44. The constitution of the metallic cyanides as deduced from their synthetic interactions: the constitution of hydrogen cyanide. By J. Wade	65	1596
45. The absorption spectra of metallic nitrates. Part I. By W. N. Hartley, D.Sc., F.R.S.	67	556
46. A method of determining the ratio of distribution of a base between two acids. By H. M. Dawson and F. E. Grant	68	512
47. On the molecular complexity of acetic acid in chloroform solution. By H. M. Dawson	69	521
48. On the existence of polyiodides in nitrobenzene solution. By H. M. Dawson and R. Gawler	69	524
49. Derivatives of α-aminocamphoroxime. By A. Lapworth and A. W. Harvey	70	549
50. Preparation of sulphamide from ammonium amidosulphite. By E. Divers and M. Ogawa	71	504
51. Hypoiodous acid. By R. L. Taylor	72	—
52. Synthesis of imino-ethers. *N*-aryl benzimino-ethers. By G. D. Lander	72	591
53. Nitration of *s*-trihalogenacetanilides. By K. J. P. Orton	73	500
54. Purpurogallin. Preliminary Notice. By A. G. Perkin and A. B. Steven	74	—
55. Quercetagetin. By A. G. Perkin	75	—

April 17*th.*

56. Dimercurammonium nitrite and its haloid derivatives. By P. C. Rây	85	644
57. Preparation and properties of 4-*iso*propyldihydroresorcin. A correction. By A. W. Crossley	86	—
58. Oxonium salts of fluoran and its derivatives. By J. T. Hewitt and J. N. Tervet	86	668

	Page in Proceedings.	Page in Transactions.
59. Influence of substitution on the reactivity of the aromatic metadiamines. By G. T. Morgan, D.Sc.	87	650
60. The influence of certain acidic oxides on the specific rotations of lactic acid and potassium lactate. By G. G. Henderson and D. Prentice, Ph.D.	88	658
61. The amounts of nitrogen as ammonia and as nitric acid, and of chlorine in the rain-water collected at Rothamsted. A report to the Lawes Trust Committee. By N. H. J. Miller	88	—
62. The amounts of nitrogen, as nitrates, and chlorine in the drainage through uncropped and unmanured land. A report to the Lawes Trust Committee. By N. H. J. Miller	89	—
63. Benzylidenecamphoroxime. By M. O. Forster	90	—

April 30*th*.

	Page in Proceedings.	Page in Transactions.
64. The preparation of absolute alcohol from strong spirit. By S. Young, D.Sc., F.R.S.	104	707
65. On the properties of mixtures of the lower alcohols with water. By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.	105	717
66. On the properties of mixtures of the lower alcohols with benzene and with benzene and water. By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.	105	739
67. Fractional distillation as a method of quantitative analysis. By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.	106	752
68. On the vapour pressures and boiling points of mixed liquids. By S. Young, D.Sc., F.R.S.	107	768
69. The correction of the boiling points of liquids from observed to normal pressure. By S. Young, D.Sc., F.R.S.	108	777
70. Vapour pressures and specific volumes of *iso*propyl *iso*butyrate. By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.	108	783
71. The preparation of highly substituted nitroaminobenzenes. By K. J. P. Orton	111	806
72. The atomic weight of tellurium. Preliminary notice. By A. Scott	112	—
73. Nitrogen bromides containing the propionyl group. By F. D. Chattaway	113	814

May 15*th*.

	Page in Proceedings.	Page in Transactions.
74. The variation with temperature of the surface-tensions and densities of liquid oxygen, nitrogen, argon, and carbon monoxide. By E. C. C. Baly and F. G. Donnan	115	907
75. Comparison of bromonitrocamphane with bromonitrocamphor. By M. O. Forster	116	865

	Page in Proceedings.	Page in Transactions.
76. $\alpha\alpha$-Benzoylnitrocamphor and $\alpha\alpha$-benzoyliodocamphor. By M. O. Forster and E. A. Jenkinson	117	—
77. 2:4-Dibromo-5-nitro- and 2:4-dibromo-3:5-dinitrotoluenes and their behaviour on reduction. By W. A. Davis	118	870
78. Note on the purification of hydrochloric acid from arsenic. By L. T. Thorne, Ph.D., and E. H. Jeffers	118	—
79. The radioactivity of thorium compounds. Part II. The cause and nature of radioactivity. By E. Rutherford and F. Soddy	120	837
80. The radioactivity of uranium. By F. Soddy	121	860

May 28*th.*

81. Taxine, the alkaloid of yew. By T. E. Thorpe, C.B., F.R.S., and G. Stubbs	123	874
82. The sampling of soils. By J. W. Leather	125	883
83. Some excessively saline Indian well waters. By J. W. Leather	127	887
84. Nitrobromo-derivatives of fluorescein. By J. T. Hewitt and A. W. G. Woodforde	128	893
85. On phosphorus sesquisulphide and its behaviour with Mitscherlich's test. By E. G. Clayton, F.I.C.	129	—
86. Atomic and molecular heats of fusion. By P. W. Robertson	131	1233
87. The preparation of mixed ketones by heating the mixed calcium salts of organic acids. By E. B. Ludlam	132	1185
88. Isomeric additive products of methyl, ethyl, and propyl benzyl ketones with benzylidene aniline. Part IV. By F. E. Francis and E. B. Ludlam	132	956
89. The influence of solvents on the rotation of optically active compounds. Part III. Influence of benzene, toluene, *o*-xylene, *m*-xylene, *p*-xylene, and mesitylene on the rotation of ethyl tartrate. By T. S. Patterson	133	1097
90. The influence of solvents on the rotation of optically active compounds. Part IV. Influence of naphthalene on the rotation of ethyl tartrate. By T. S. Patterson	133	1134

June 5*th.*

91. The action of ungerminated barley diastase on starch. Part I. By J. L. Baker	134	1177
92. The decomposition of chlorates. Part V. Potassium chlorate in presence of oxides of manganese, and the theory of perchlorate formation. By W. H. Sodeau, B.Sc.	136	1066
93. Studies in the tetrahydronaphthalene series. I. The diazoamino-compounds of *ar*-tetrahydro-β-naphthalene. By C. Smith, B.Sc.	137	900

	Page in Proceedings.	Page in Transactions.
94. Experiments on phosphorus tetroxide. By C. A. West, B.Sc.	138	923
95. The decomposition of compounds of selenium and tellurium by moulds and its influence on the biological test for arsenic. By O. Rosenheim, Ph.D.	138	—
96. Constituents of Gambier and Acacia catechus. By A. G. Perkin and E. Yoshitake	139	1160
97. The decomposition of oxalacetic hydrazone in aqueous and acid solution, and a new method of determining the concentration of hydrogen ions in solution. By H. O. Jones and O. W. Richardson	140	1140
98. The dissociation constants of oxalacetic acid and its hydrazone. By H. O. Jones and O. W. Richardson.	141	1158
99. Derivatives of butyrylpyruvic acid. By A. Lapworth and A. C. O. Hann	141	1485
100. Sulphocampholenecarboxylic acid. By A. W. Harvey and A. Lapworth	142	—
101. Some properties of camphorquinonephenylhydrazone. By A. Lapworth and A. C. O. Hann	143	1508
102. Optically active esters of β-ketonic and β-aldehydic acids. Part I. Menthyl hydroxymethylenephenylacetate. By A. Lapworth and A. C. O. Hann	144	1491
103. Optically active esters of β-ketonic and β-aldehydic acids. Part II. Menthyl acetoacetate. By A. Lapworth and A. C. O. Hann	145	1499
104. The mechanism of simple desmotropic change. By A. Lapworth and A. C. O. Hann	146	1508
105. Trimethylbrazilone. By W. H. Perkin, jun.	147	1008

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106. Elimination of a nitro-group on diazotisation. Dinitro-*p*-anisidine. By R. Meldola and J. V. Eyre	160	988
107. Preliminary notice of some new derivatives of pinene and other terpenes. By W. A. Tilden and H. Burrows	161	—
108. The colour changes exhibited by the chlorides of cobalt and some other metals from the standpoint of the theory of electro-affinity. By F. G. Donnan and H. Bassett, jun	164	939
109. The stereochemical formulæ of benzene. By J. E. Marsh	164	961
110. An accurate method of determining the compressibility of vapours. By B. D. Steele, D.Sc.	165	1076
111. A new type of substituted nitrogen chlorides. By F. D. Chattaway	165	—
112. The preparation of pure chlorine and its behaviour towards hydrogen. By J. W. Mellor and E. J. Russell	166	1272
113. Derivatives of dibenzoylmesitylene. By W. H. Mills and T. H. Easterfield	167	1311
114. The molecular condition of borax in solution. By H. S. Shelton	169	—

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115. On the union of hydrogen and chlorine. Part V. By J. W. Mellor, D.Sc.	169	1280
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117. On some hydroxy-pyrone derivatives. By T. Tickle and J. N. Collie, F.R.S.	170	1004
118. The absorption spectra of phloroglucinol and some of its derivatives. By W, N. Hartley, D.Sc., F.R.S., J. J. Dobbie, D.Sc., M.A., and A. Lauder, B.Sc.	171	929
119. Solubility of mannitol, picric acid, and anthracene. By A. Findlay	172	1217
120. Menthyl formylphenylacetate. By J. B. Cohen and S. H. C. Briggs	172	—
121. Transformation of diacetanilide in aceto-*p*-amino-acetophenone. By F. D. Chattaway	173	—
122. Nitrogen chlorides and bromides derived from ortho-substituted anilides. By F. D. Chattaway and J. M. Wadmore	173	984
123. Substituted nitrogen chlorides containing the azo-group. By F. D. Chattaway	174	982
124. The action of chlorine and bromine on nitroaminobenzenes. Part I. *s*-Trisubstituted chloronitroaminobenzenes. By K. J. P. Orton	174	965
125. The transformation of diazoamido- into aminoazo-compounds and of hydrazobenzene into benzidine. By F. D. Chattaway	175	—
126. Tribromophenol bromide. By E. W. Lewis	177	1001

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127. On the solvent properties of mixed liquids in relation to the chemical characters and solvent properties of their components. By H. M. Dawson	179	1086
128. Notes on luteolin and apigenin. By A. G. Perkin	180	1174
129. Note on a simple form of Landsberger's apparatus. By E. B. Ludlam	180	1193
130. The action of substituting agents on benzeneazo-β-naphthol. By J. T. Hewitt and S. J. M. Auld	180	1202
131. The condensation of dimethylaminobenzaldehyde with β-naphthol. By J. T. Hewitt, A. J. Turner, B.Sc., and S. W. Bradley	181	1207
132. The action of ethyl chlorofumarate on monoalkylmalonic esters. By S. Ruhemann	181	1212
133. Di-*sec*.-octyl tartrate and di-*sec*.-octyl dibenzoyl tartrate. By J. McCrae	182	1221
134. Glycogen from yeast. By A. Harden and W. J. Young	182	1224
135. The action of acetylene on the acetates of mercury. By E. Burkard, Ph.D., and M. W. Travers, D.Sc.	183	1270

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136. The decomposition of water vapour by the electric spark. By D. L. Chapman and F. A. Lidbury	183	1301
137. The chlorination of the dichlorotoluenes in presence of the aluminium-mercury couple. The constitution of the trichlorotoluenes. By J. B. Cohen and H. D. Dakin	183	1324
138. The constitution of the nitro- and dinitro-derivatives of the dichlorotoluenes. By J. B. Cohen and H. D. Dakin	184	1344
139. Iodonium compounds of the type $IR'R''R'''$, and the configuration of the iodine atom. By H. Peters	184	1350
140. Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part II. By G. T. Morgan, D.Sc.	185	1376
141. Observations on the phenomena and products of the decomposition of normal cupric acetate when heated. By A. Angel and A. V. Harcourt	185	1385
142. The resolution of β-hydroxybutyric acid into its optically active components. By A. McKenzie	185	1402
143. The rate of decomposition of diazo-compounds. Part I. Diazo-compounds of the benzene series. By J. C. Cain and F. Nicoll	186	1412
144. Studies upon the action of sodamide and acetyl substituted sodamides upon organic esters. By A. W. Titherley, D.Sc., Ph.D.	186	1520

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145. The specific heats of gases. By H. Crompton	188	—
146. The action of nitric acid on bromophenolic compounds. By W. Robertson	189	1475
147. 3 : 5-Dichloro-*o*-xylene and 3 : 5-dichloro-*o*-phthalic acid. By A. W. Crossley and H. R. Le Sueur	190	1533
148. The combination of carbon monoxide with chlorine under the influence of light. By G. Dyson and A. Harden	191	201*
149. The constituents of commercial chrysarobin. By H. A. D. Jowett, D.Sc., and C. E. Potter, B.Sc.	191	1575
150. The constituents of an essential oil of rue. By F. B. Power and F. H. Lees	192	1585
151. Methyl β-methylhexyl ketone. By F. H. Lees	193	1594
152. Di-indigotin. By J. Moir, M.A., D.Sc.	194	—
153. Note on the localisation of phosphates in the sugar cane. By C. H. G. Sprankling	196	1543
154. On the non-existence of the gaseous sulphide of carbon described by Deninger. By E. J. Russell and N. Smith	197	1538
155. Hydroxyoxamides. Part II. By R. H. Pickard, C. Allen, W. A. Bowdler, and W. Carter	197	1563
156. Isometric anhydrous sulphates of the form $M''SO_4,R_2'SO_4$. By F. R. Mallet	198	1546

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157. The catalytic racemisation of amygdalin. By J. W. Walker	198	—
158. On asymmetric optically active selenium compounds and on the sexavalency of selenium and sulphur. By W. J. Pope, F.R.S., and A. Neville, B.Sc.	198	1552
159. The transformation of acetylchloroaminobenzenes into the isomeric chloroacetanilides. By F. D. Chattaway and K. J. P. Orton	200	—

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161. Isomeric partially racemic salts containing quinquevalent nitrogen. Part VIII. Resolution of the hydrindamine bromocamphorsulphonates. By F. S. Kipping.	209	—
162. Isomeric compounds of the type $NR_1R_2H_3$. By F. S. Kipping.	211	—
163. The oxime of mesoxamide and some allied compounds. Part II. Disubstituted derivatives. By Miss M. A. Whiteley, D.Sc.	212	24*
164. Interaction of ketones and aldehydes with acid chlorides—the formation of benzoxyolefines and l-benzoxycamphene. By F. H. Lees.	213	145*
165. The synthesis of *αα*-dimethylglutaric acid, of *β*-hydroxy-*αα*-dimethylglutaric acid, and of the *cis*- and *trans*-modifications of *αα*-dimethylglutaconic acid. By W. H. Perkin, jun., and Miss A. E. Smith.	214	8*
166. A reaction of some phenolic colouring matters. II. By A. G. Perkin and C. R. Wilson.	215	129*
167. Note on mixtures of constant boiling point. By S. Young, D.Sc., F.R.S.	215	77*
168. The vapour pressures and boiling points of mixed liquids. Part II. By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.	216	45*
169. The vapour pressures and boiling points of mixed liquids. Part III. By S. Young, D.Sc., F.R.S.	218	68*
170. Note on the condensation points of the thorium and radium emanations. By E. Rutherford and F. Soddy.	219	—
171. Note on the action of barium hydroxide on dimethylvioluric acid. By Miss M. A. Whiteley, D.Sc.	220	18*
172. The determination of strychnine and brucine in nux vomica. By E. Dowzard	220	—

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175. Isomeric benzoyl derivatives from *iso*nitrosocamphor. By M. O. Forster	238	—
176. Action of phosphorus haloids on dihydroresorcins. Part I. Dimethyldihydroresorcin. By A. W. Crossley and H. R. Le Sueur	238	110*
177. The absorption spectra of metallic nitrates. Part II. By W. N. Hartley, D.Sc , F.R.S.	239	221*
178. The constitution of the products of nitration of meta-acetoluidide. By J. B. Cohen and H. D. Dakin	240	321*
179. The action of metallic thiocyanates upon carbonyl chloride. By A. E. Dixon	240	84*
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180. A reagent for the identification of carbamide and of certain other nitrogen compounds. By H. J. H. Fenton	243	187*
181. The rate of decomposition of diazo-compounds. Part II. Diazo-compounds of the naphthalene series. By J. C. Cain and F. Nicoll	244	206*
182. State of carbon dioxide in aqueous solution. By J. Walker.	246	182*
183. Qualitative separation of arsenic, antimony, and tin. By J. Walker	246	184*
184. The hydrates and solubility of barium acetate. By J. Walker and W. A. Fyffe	246	173*
185. *cis*- and *trans*-$\alpha\beta$-Dimethylglutaric acid and the separation of *cis*- and *trans*-forms of substituted glutaric acids. By J. F. Thorpe and W. J. Young	247	351*
186. Constitution of metallic cyanides. By J. E. Marsh...	248	—
187. Auto-reduction of mercury and silver cyanides. By J. E. Marsh and R. de J. F. Struthers	249	—
188. Note on the action of acids on cellulose. By Miss M. Gostling, B.Sc.	250	190*
189. Nitrotartaric acid and some of its ethereal salts. By P. F. Frankland, H. L. Heathcote, B.Sc., and Miss H. Hartle, B.Sc.	250	154*
190. The nitration of diethyl monobenzoyl- and mono-*p*-toluyl-tartrates. By P. F. Frankland, H. L. Heathcote, B.Sc., and C. J. Green, M.Sc.	251	168*
191. Interchange of halogen for hydroxyl in chloro- and bromo-naphthalenediazonium hydroxides. Preliminary notice. By K. J. P. Orton	252	—

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

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Vol. 18. No. 245.

January 16th, 1902. Prof. Emerson Reynolds, Sc.D., V.P.R.S., President, in the Chair.

Messrs. Jollyman, Kettle, and J. H. Allworthy were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Edwin Bayles Atkinson, Scartho House, Great Grimsby; Matthew Bradbury Challen, Daylesford, Victoria; Noël Heaton, 20, Girdlers Road, West Kensington, W.; William Brannan Jackson, Glengowan, Caldercruix, N.B.; Selwyn Philip James Lavelle, Royston Villa, Ashby Road, Burton-on-Trent; Allan Ogilvie, 19, Market Street, Millom, Cumberland; Nevil Vincent Sidgwick, Lincoln College, Oxford; James Swain, 17, Winsham Street, West Side, Clapham Common, S.W.

DAY AND HOUR OF MEETING.

The Council has decided, on the recommendation of the Committee appointed for the purpose, that for the remainder of the Session the Ordinary Meetings of the Society shall be held at the following times:

	January.	
Thursday	Jan. 16	at 8.0 p.m.
	February.	
Thursday	Feb. 6	„ 8.0 „
Wednesday	„ 19	„ 5.30 „

	MARCH.	
Thursday	March 6	at 8.0 p.m.
Wednesday	„ 19	„ 5.30 „
	APRIL.	
Thursday	April 17	„ 8.0 „
Wednesday	„ 30	„ 5.30 „
	MAY.	
Thursday	May 15	„ 8.0 „
Wednesday	„ 28	„ 5.30 „
	JUNE.	
Thursday	June 5	„ 8.0 „
Wednesday	„ 18	„ 5.30 „

Annual General Meeting, Wednesday, March 26, at 4.30 p.m.

Of the following papers those marked * were read :

***1. "An investigation of the radioactive emanation produced by thorium compounds." I. By E. Rutherford, M.A., D.Sc., and F. Soddy, B.A.**

The main questions examined by the authors are (1) Can thoria, the emanating power of which has been largely destroyed by ignition, have this property restored to it by chemical treatment ? (2) Is emanating power to be regarded as a specific property of thorium, or is it due to the presence of a foreign material ? (3) Does the radioactive emanation itself resemble in chemical nature any known substance ?

The electrical methods employed for the measurement of emanating power and radioactivity depend on the universal property of the radiations from substances known as radioactive of ionising or producing charged carriers from the gas through which they pass whereby the gas is rendered capable of conducting a current of electricity. The amount of the current, measured by means of a quadrant electrometer, affords the means of comparing the intensities of radiations, and the method is capable of a degree of precision and rapidity impossible with the better known photographic method. Use was made of the rate of decay of the radiation from the emanation with lapse of time to recognise and distinguish between different types of emanation, and the study of the phenomena is thus rendered qualitative as well as quantitative in character. The means employed for eliminating the effects of the emanation from the effects of the straight line radiation and *vice versâ* were explained.

The first question is conclusively answered in the affirmative. After solution and reprecipitation, no difference was observed in the emanating powers of thorium compounds prepared from ordinary thoria and thoria de-emanated as completely as possible by intense ignition. The latter process must therefore be regarded as an obliteration of the effect rather than a removal of the cause. The de-emanation of thoria by ignition leaves the straight line radioactivity quite unaffected.

With regard to the second question, the attempts first made to separate from thorium a substance to which the emanating power could be traced were not successful. These included a fractionation of the sulphate and a precipitation of thoria by potassium azoimide according to the method of Dennis. No change in either the emanating power or radioactivity was observed in thoria prepared by these methods. Subsequently, results of a different character were obtained.

It was found that water vapour increases and desiccation decreases the normal value of the emanating power, the extremes varying in the ratio of 2 to 1. Cooling acts powerfully in the opposite direction to increase of temperature. At $-78°$, the emanating power was only one-tenth of the normal, but no permanent alteration in value is produced. The lapse of time in increasing the emanating power of freshly prepared thorium hydroxide is very striking. A maximum value appears to be attained after some days, and this is not much affected by sealing up the substance in glass.

An investigation of the third point, the chemical nature of the emanation itself, showed that this possesses the property of chemical inertness which characterises the members of the argon family. Using in the different cases suitable gases to carry the emanation from the thoria, it was subjected to the action of the following reagents on its way to the testing apparatus: red-hot lead chromate, white-hot platinum, platinum black raised gradually to a white heat, red-hot magnesium, zinc dust, and palladium black. In each case the radioactivity of the gas current was quite unaffected, proving that, not only is the emanation not absorbed by these reagents, but also that its radioactivity is not thereby affected. The possible explanation that the emanation is the manifestation of excited radioactivity on the surrounding atmosphere was shown to be untenable by a crucial experiment. Since the only known gases which would survive in unaltered amount the action of all the reagents employed are the gases of the argon family, the authors conclude that the emanation is allied in properties to the elements of this group.

The emanating power of thorium nitrate, which in the solid state is only 1·8 per cent. of that of thoria, is increased 200 times by solution in water. It was also found that the emanating power of the carbonate varies enormously with the method of preparation, and specimens of it have been obtained differing in the ratio of 80 to 1, of which the highest possesses four times the value of thoria.

A remarkable observation has been made on the solutions from which thorium has been precipitated with ammonia; although these should be free from thoria, they still possess both emanating power and radioactivity in considerable amounts. This has led to the preparation of substances free from thorium, but possessing radioactivity and emanating power indistinguishable from that of thorium, many hundred, in some cases over a thousand, times as active. The identity extended to the penetration power of the rays for metals and the rate of decay of the emanation. The fact that those processes in which a portion of the emanating material is certainly removed from thorium does not much affect the value of the emanating power of the latter, taken in conjunction with the very great variations which this value suffers in different circumstances and often spontaneously with time, leads to the belief that emanating power is the manifestation of a dynamical change rather than a function of matter in the static condition. In the same way as in chemical reaction, the active mass of a reacting solid appears independent of its quantity, so the rate of the change, of which emanating power is a measure, does not depend solely or even mainly on the quantity of emanating material present. The removal of the latter is consequently not accompanied by corresponding changes in the emanating power. The straight line radioactivity, on the other hand, is apparently unaffected by any of the causes which so profoundly alter the value of the emanating power, and appears much more likely to be additive with regard to mass. The effect of the removal of an intensely radioactive and emanating material from thorium is found, in accordance with this view, to reduce the straight line radioactivity of the thorium very materially. These results show that thorium is partially separated from ThX, the constituent responsible for its activity, and the latter can be obtained free from thorium.

The chemical examination of the thorium-free active substances prepared in the manner described showed the presence of an unknown substance, precipitated from its solutions by sodium phosphate. This the authors regard as merely an accidental impurity. The actual ThX is probably present only in minute quantity, exhibiting the behaviour of being dragged down by precipitates, without reference to its true analytical behaviour.

Another method of separation confirms this view. By evaporation of water with which thoria has been shaken for some time, small deposits are obtained which are often of the order of a thousand fold more active than the original thoria. The washed sample exhibits a considerable reduction of radioactivity after the process, whilst the character of the radiations as before is identical with the ordinary thorium radiation. A careful chemical examination failed to reveal the presence of any other element besides thorium. The view that the radioactivity and emanating power of thorium is to be ascribed to the presence of a minute amount of a constituent ThX of correspondingly great activity is thus confirmed.

Discussion.

Mr. Vernon Harcourt had previously read two papers by Professor Rutherford in the *Philosophical Magazine* which explained the apparatus used by the authors. The authors' conclusion that the influence upon the conducting power of air or other gas interposed between oppositely electrified surfaces is due, not to an imponderable force radiating from the molecules of thoria, but to the escape in minute quantity of some substance which is mixed with the thoria, and which can be dissolved and precipitated, was of very great interest. He might recall the observations and conclusions of Dr. Russell, who had investigated the photographic effect of the emanation from a number of substances, and had similarly concluded that the results were due, not to such an agent as light or electricity, but to the action of hydrogen peroxide.

*2. "The constitution of hydrocyanic, cyanic, and cyanuric acids." By F. D. Chattaway and J. M. Wadmore.

A study of the behaviour of cyanogen chloride, bromide, and iodide shows that they possess the typical and characteristic properties of compounds in which halogen is attached to nitrogen.

They react, for example, quantitatively with solutions of hydriodic acid, sulphurous acid, and hydrogen sulphide, hydrocyanic acid being in each case reformed, whilst iodine, sulphuric acid, and sulphur respectively are produced.

They must consequently be regarded as imino-derivatives and be represented by the constitutional formulæ,

$$C\!:\!N{\cdot}Cl \qquad C\!:\!N{\cdot}Br \qquad C\!:\!N{\cdot}I.$$

The ease with which the cyanogen halogen compounds can be formed from hydrocyanic acid and its salts and again transformed into them makes it in the highest degree probable that these also have the imino-constitution and must be represented by formulæ such as

$$C\!:\!N{\cdot}H \qquad C\!:\!N{\cdot}K \qquad C\!:\!N{\cdot}Ag.$$

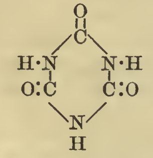
Since the cyanides and cyanogen halogen compounds have the above structure, their relations with cyanic acid and the cyanates point to the probability of the latter also having the *iso*-constitution:

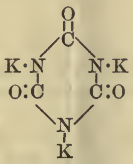
$$O{:}C{:}N\cdot H \qquad O{:}C{:}N\cdot K \qquad O{:}C{:}N\cdot Ag.$$

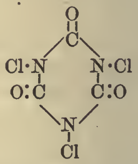
Cyanuric acid also yields a derivative in which all its hydrogen is replaced by chlorine and which has the composition $C_3O_3N_3Cl_3$. It is formed by the action of chlorine on a solution of potassium cyanurate. It is a white powder, insoluble or soluble only with decomposition in most ordinary solvents, which under the microscope is seen to consist of short prisms, m. p. 245°.

Its behaviour shows that the whole of its chlorine is attached to nitrogen. It liberates chlorine when treated with hydrochloric acid, iodine with hydriodic acid, and oxidises sulphurous to sulphuric acid; it reacts explosively with a strong solution of ammonia, nitrogen being evolved, and also with a solution of hydrogen sulphide, setting free sulphur; cyanuric acid is in each case reformed.

Since cyanurates are readily and completely converted into this trichlorimino-derivative, and the latter in many reactions equally readily and completely again into cyanuric acid, the conclusion is justified that the latter and its derivatives are imino- and not hydroxy-compounds, and assuming the ring structure, they must therefore be represented by the formulæ:







A similar study of the behaviour of cyanuric chloride and bromide shows that in them the halogen is attached to carbon and not to nitrogen.

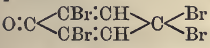
Discussion.

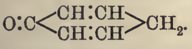
Professor Dobbie said that in a paper (Hartley, Dobbie, and Lauder, *Trans.*, 1901, **79**, 848) on the absorption spectra of cyanogen compounds, it had been pointed out that if cyanuric acid possessed the formula usually assigned to it, it differed from all substances hitherto examined in which carbon and nitrogen atoms were united by alternate double and single bonds in showing no selective absorption. This was the case, however, not only with the derivatives of cyanuric, but also of those of *iso*cyanuric acid, so that if cyanuric acid possessed the imino-structure attributed to it by the authors, there still remained the difficulty of satisfactorily representing the constitution of the *iso*-derivatives. All that spectroscopic examination proves is that it is extremely unlikely that any of these compounds possess a structure analogous to that of pyridine or dimethylpyrazine.

Mr. C. E. Groves said that the very interesting substance, $C_3O_3N_3Cl_3$, to which the authors had given the name of trichloraminocyanuric acid, seemed to have rather the properties of a hypochlorite. Several ring compounds were known somewhat analogous to it in properties, of which the constitutions were accurately known in so far that the chlorine was certainly not attached to nitrogen; such, for instance, was the compound obtained by chlorinating trichloro-orcinol, $C_6Cl_3Me(OH)_2$, which might be represented by the hypochlorite formula, $C_6Cl_3Me(OCl)_2$. If this view were adopted, the formula of the new substance might be represented as $C_3N_3(OCl)_3$, in harmony with that usually assigned to cyanuric acid, $C_3N_3(OH)_3$.

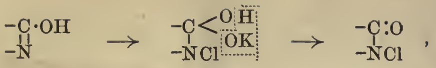
Dr. Lapworth thought that, even if the halogen derivatives referred to had the constitutions which it was proposed to assign to them, it did not follow that the acids from which they are obtained had the same structure. The conclusions drawn were no doubt correct, but this had been decided by physical methods. Reasoning based on the assumption that a substituting atom or group takes up the position originally occupied by the atom displaced could only be accepted with the utmost caution when the molecule is of a labile type.

Thus, in the replacement of the metal in ethyl sodioacetoacetate by alkyls, the new group becomes attached to the carbon atom, but it is not generally conceded that the metal in the original compound occupied that position. Again, by the action of bromine water on phenol, a tetrabromo-substitution product having the structure


$O{:}C<\begin{smallmatrix}CBr{:}CH\\CBr{:}CH\end{smallmatrix}>C<\begin{smallmatrix}Br\\Br\end{smallmatrix}$ is obtained (*Ber.*, 1900, 33, 674), but this is not a sufficient reason for representing phenol by the formula


$O{:}C<\begin{smallmatrix}CH{:}CH\\CH{:}CH\end{smallmatrix}>CH_2$. In such cases the reactions are open to several interpretations, and in the present case the substitution experiments may be explained equally well by using the alternative formulæ for the acids.

Dr. Forster pointed out that the conversion of cyanuric acid into the chloro-derivative by the action of chlorine on a solution of the acid in potassium hydroxide is an argument which supports the hydroxylic representation of cyanuric acid quite as strongly as the iminic, the change represented by the formula,



$$\begin{array}{l}-\mathrm{C{\cdot}OH}\\ \;\,\| \\ -\mathrm{N}\end{array} \longrightarrow \begin{array}{l}-\mathrm{C}<^{\mathrm{O}\,\mathrm{H}}_{\mathrm{OK}}\\ \;\,| \\ -\mathrm{NCl}\end{array} \longrightarrow \begin{array}{l}-\mathrm{C{:}O}\\ \;\,| \\ -\mathrm{NCl}\end{array},$$

leading easily from hydroxylic cyanuric acid to the nitrogen chloride derivative.

Dr. Travers remarked that though the authors had referred to the work of Hartley and others as supporting their theory, the researches of these same investigators on isatin and its methyl derivatives pointed to the danger of accepting such conclusions. Since *ketonic* isatin gives rise, by treating its salts with methyl iodide, to *enolic* methyl isatin, obviously no conclusion could be drawn from such a reaction, which they explain on the basis of the ionic theory.

Professor Dunstan was of opinion that in general the tautomerism of these cyanogen derivatives renders it impossible to assign to any one of them a formula which will satisfactorily account for all its reactions. The authors had obtained a very interesting chlorine derivative of cyanuric acid, but its behaviour did not appear to be inconsistent with its being regarded as containing chlorine in the place of the hydrogen of three hydroxyl groups. He considered improbable the authors' explanation of its decomposition by hydrochloric acid giving free chlorine.

Dr. Chattaway in reply said that their work neither proved nor disproved the cyclic constitution of cyanuric acid; it only showed that, whatever the formula, the whole of the hydrogen was attached to nitrogen, and therefore the hydroxylic formula was not possible.

The stability of the chlorine derivative of cyanuric acid and the analogy of its reactions with those of substances such as nitrogen iodide and cyanogen iodide showed that it could not contain –O–Cl groups.

*3. "A modification of Zeisel's method for the estimation of methoxyl groups." By J. T. Hewitt and T. S. Moore.

The authors described a modification of Zeisel's well-known method in which the condenser supplied with water at 40° is replaced by a fractionating column; this is so efficient that the potash bulbs containing water with red phosphorus in suspension may be dispensed with. The time taken in fitting up the apparatus and in carrying out the operation is much less than in Zeisel's original method. Experimental data were given showing the accuracy attainable.

*4. "A new colour reaction of hydroxylamine." By W. C. Ball, B.A.

During the course of some experiments on the action of hydroxylamine salts on nickel sulphide, the author obtained an intense purple coloration, which proved eventually to be independent of the presence of nickel or any other metal.

The production of this colour is a very delicate test for hydroxylamine, as solutions so dilute as no longer to reduce Fehling's solution perceptibly, either in the cold or on boiling, easily respond to this test. The best method of applying the reaction is to boil the hydroxylamine solution with one or two drops of yellow ammonium sulphide solution until a precipitate of sulphur is produced; two or three cubic centimetres of 0·880 ammonia solution are then added, and finally an equal volume of strong pure alcohol.

The purple colour thus developed exhibits a characteristic absorption spectrum, consisting of a wide band covering the yellow, orange and part of the green. In stronger solutions, the violet and blue are absorbed, and in very strong solutions the green rays also, so that the only light transmitted is a band in the red.

With a dilution of 1 part of hydroxylamine in 2000 of water the coloration is intense and the band very distinct; with a dilution of 1 part in 300,000 of water, the coloration is still strong, and the band perceptible in 3 centimetres thickness of the solution. By means of this test hydroxylamine may be detected when the dilution does not exceed 1 part in 500,000 of water.

The production of the colour is well adapted for showing the formation of hydroxylamine by the action of metals, for example, tin, on nitric acid. It also serves as a very good means of distinguishing hydroxylamine from hydrazine, as the latter base does not produce the colour. The coloured substance is also produced, and can be obtained in the solid form, by the action of dry ammonia on an alcoholic solution of sulphur monobromide, or an acetone solution of nitrogen sulphide in presence of a little hydrogen sulphide.

The colouring matter seems to be the same as that observed by Fordos and Gélis when nitrogen sulphide containing sulphur is treated with alcoholic potash.

The absorption spectrum of the compound appears to be identical with that of Moissan's sulphammonium, obtained by the action of liquid ammonia on sulphur.

The author is endeavouring to obtain the substance pure enough for analysis.

*5. "On the sensitiveness of a thermoregulator." By A. W. C. Menzies.

The following details have been recorded, as it is not generally known within what small limits of temperature a bath may be kept constant, using gas heating and the ordinary form of regulator. The glass 'horseshoe' reservoir was of the usual form, with a capacity of 390 c.c. and an outer surface of about 650 sq. cm.; to this reservoir the ordinary U-form regulating tube which contains mercury, was fused on and the glass connections so bent that all the tubes containing enclosed liquid were under the water of the bath. As toluene was used for the expanding liquid, the stopcock that closes one limb of the U-tube was lubricated with syrupy phosphoric acid. The bath held 14 litres and was of enamelled iron, with no jacket. The stirrer was driven by a small electromotor, and care was taken that a portion of the vibration of the motor was communicated to the regulator, thus aiding the free movement of the mercury in response to the pressure of the toluene. The gas supply to the bye-pass was adjusted by a screw-clip in such a way that the bye-pass flame alone was nearly sufficient to maintain the temperature. Using a tube of 3·1 mm. bore for the outer limb of the regulator, the temperature of the bath can be kept constant at 18° within a total range of 0·008°, that is, 0·004° on each side of the middle point. After 24 days, using unfiltered coal-gas, the actual temperature was the same as at starting, and the closeness of regulation was found still within the above limits. If narrower tubes be used, it is well to dry and filter the gas. The inlet tube that leads the gas down to the surface of the mercury is cut off square and should be so wide that on trial the mercury rises higher in it than in the space between it and the regulator tube. A bore of 1·9 mm. for the outer limb of the regulator gave a temperature variation in the bath of not more (though probably less) than 0·0025 (total range). The difference of temperature between bath and room was 6—7°; if the flame were removed, the bath was found to cool 0·1° in 4·5 minutes. With this regulator, a well-tapped calorimetric thermometer by Golaz, divided into fiftieths of a degree, remained apparently stationary to an estimated tenth-division, as also did a "Beckmann" thermometer graduated directly to hundredths. The limits actually registered by two large special alcohol thermometers (one with a bulb of extremely thin glass 180 mm. long and 5 mm. in diameter) were less than those stated above, which are given after making due allowance for the sluggishness of action of such thermometers.

6. "Myricetin. Part II." By A. G. Perkin.

Myricetin (*Trans.*, 1896, 1287), air-dried, has the formula $C_{15}H_{10}O_8,H_2O$, is anhydrous at 160°, and melts about 357°. The compound previously obtained by the action of bromine is *tetrabrom-myricetin*, $C_{15}H_6Br_4O_8$, and is converted by hydriodic acid into myricetin. *Myricetinpentamethyl ether*, $C_{15}H_5O_3(OCH_3)_5$, m. p. 138—139°, forms a *monoacetyl* derivative, $C_{15}H_4O_3(OCH_3)_5(C_2H_3O)$, colourless needles, m. p. 167—170°, and on decomposition gives gallic acid trimethyl ether and phloroglucinol monomethyl ether, the latter identified by its diazobenzene derivative (m. p. 250—252°). *Myricetinhexaethyl ether*, $C_{15}H_4O_2(OEt)_6$ almost colourless needles, m. p. 149—151°, yields gallic acid triethyl ether and a phenol, probably phloroglucinol diethyl ether (azobenzene compound, yellow needles, m. p. 163—165°). Acetylmyricetin melts at 211—212° and not at 204—206° as previously stated.

Myricetrin, air-dried, $C_{21}H_{22}O_{13},H_2O$; at 160°, $C_{21}H_{22}O_{13}$, pale yellow leaflets, m. p. 199—200°; a new glucoside, occurs in the bark of the *Myrica nagi*, and is decomposed by acid into myricetin and rhamnose, $C_{21}H_{22}O_{13} + H_2O = C_{15}H_{10}O_8 + C_6H_{14}O_6$. It closely resembles quercitrin.

7. "The colouring matters of green ebony." By A. G. Perkin and S. H. C. Briggs.

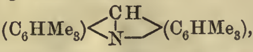
Green ebony is a yellow dyewood, probably *Excoecaria glandulosa* or *Jacaranda ovalifolia*, until recently employed in this country. It contains two crystalline colouring matters, excoecarin and jacarandin, in minute quantity. *Excoecarin*, $C_{13}H_{12}O_5$, yellow needles, m. p. 219—221°, a weak, substantive dyestuff with animal fibres, forms a *tribenzoyl* compound, $C_{13}H_9O_5(C_7H_5O)_3$, colourless needles, m. p. 168—171°, and a *dimethyl* ether, m. p. 117—119°, yellow needles, giving fluorescent solutions. On fusion with alkali, it yields *hydrotoluquinone* ($CH_3:O:O = 1:2:5$), and *hydroquinone carboxylic acid*, the latter apparently derived from the former. Bromine in presence of alcoholic potassium acetate forms *excoecarone*, $C_{13}H_{10}O_5$, copper coloured needles, m. p. about 250°, which on reduction is reconverted into excoecarin. Alcoholic quinone solution gives a similar compound ($C_{19}H_{14}O_7$?), green leaflets, m. p. 190°, which is possibly a quinhydrone derivative. *Jacarandin*, $C_{14}H_{12}O_5$, yellow plates, m. p. 243—245°, resembles luteolin in dyeing property, and gives a *diacetyl*, $C_{14}H_{10}O_5(C_2H_3O)_2$, yellow needles, m. p. 192—194°, and a *dibenzoyl* derivative, $C_{14}H_{10}O_5(C_7H_5O)_2$, yellow prismatic needles, m. p. 167—169°. With alcoholic potassium acetate the *salt*, $C_{28}H_{23}O_{10}K$, yellow needles, results, and on fusion with alkali an acid, apparently derived from catechol, is formed. The wood contains also two orange coloured resins, one of which is a yellow dyestuff, but the other is devoid of tinctorial property.

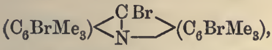
8. "The action of methylene iodide on aryl- and naphthyl-amines: diarylmethylenediamines, acridines, and naphthacridines." By A. Senier and W. Goodwin.

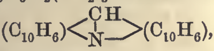
The compounds obtained by the interaction of methylene iodide and arylamines (*Trans.*, 1901, **72**, 254) were believed to be arylmethylenediamines. The study of these compounds now proves that in the case of the reaction with aniline, the toluidines, and xylidine, such diamines are formed. With ψ-cumidine, however, the well-defined, beautiful, yellow, crystalline compound which results is shown to be a condensation product. Its analysis, vapour density, the fluorescence of its solutions, and the analogy of its formation to the anthracene synthesis of Friedel and Crafts (*Ann. Phys.*, 1887, [vi], **11**, 263) and the acridine synthesis of Bernthsen and Bender (*Ber.*, 1883, **16**, 1802), indicate it to be an acridine:—hexamethylacridine. This view is confirmed by the exactly parallel behaviour of both α- and β-naphthylamine with methylene iodide, giving rise to similar compounds, and the identity of the β-compound with the β-naphthacridine already known. This naphthacridine was discovered by Reed, using a different reaction (*J. pr. Chem.*, [ii], 1886, **34**, 160; 1887, **35**, 298), and has led to interesting results in the hands of Morgan (*Trans.*, 1898, **73**, 536).

The further study of the properties and constitution of hexamethylacridine and α-naphthacridine is being proceeded with and is reserved for a future communication.

The following compounds were described: *Diphenylmethylenediamine*, $CH_2(NHPh)_2$, dark yellow powder, m. p. 65—67°. *Diphenylmethylenediamine platinichloride*, $(C_{13}H_{14}N_2)H_2PtCl_6$, olive-green powder. *Dicarbanilidodiphenylmethylenediamine*, $CH_2(NPh{\cdot}CO{\cdot}NHPh)$. *Ditolylmethylenediamines*, $CH_2(NHC_6H_4Me)_2$; o-*derivative*, colourless crystals, m. p. 156—157°; p-*derivative*, pale yellow crystals, m. p. 149—150°; m-*derivative*, yellow, amorphous but not definite. *Dixylylmethylenediamine*, $CH_2(NHC_6H_3Me_2)_2$, pale yellow, large foliate crystals, m. p. 127—128°. *Dixylylmethylenediamine platinichloride*, $(C_{17}H_{22}N_2)H_2PtCl_6$, golden-yellow powder. *Dicarbanilidocarbanilidodixylylmethylenediamine*, $CH_2[N(C_6H_3Me_2){\cdot}CO{\cdot}NPh{\cdot}CO{\cdot}NHPh]_2$, yellowish-white substance resembling wax, yielding colourless needles when recrystallised, m. p. 203°.



Hexamethylacridine, $(C_6HMe_3)\left\langle\begin{matrix}CH\\|\\N\end{matrix}\right\rangle(C_6HMe_3)$, fine yellow needles, m. p. 221—222°, sublimes readily, solutions fluorescent. *Hexamethylacridine picrate*, $(C_{19}H_{21}N)C_6H_2(NO_2)_3OH$, fine, brown, plume-like crystals, m. p. 200—202°. *Dinitrohexamethylacridine*, $C_{19}H_{19}(NO_2)_2N$, yellow powder, m. p. 85—87°. *Tribromohexamethylacridine*,  $(C_6BrMe_3)<\overset{CBr}{\underset{N}{|}}>(C_6BrMe_3)$, red. *Hexamethylacridine nitrate*, $(C_{19}H_{21}N)HNO_3$, bright scarlet needles, m. p. 163—164° with decomposition. *Hexamethylacridine platinichloride*, $(C_{19}H_{21}N)_2H_2PtCl_6$, scarlet needles. *Hexamethylacridine aurichloride*, $(C_{19}H_{21}N)HAuCl_4$, yellow powder. *Hexamethylacridine mercurichloride*, $(C_{19}H_{21}N)HgCl_2$, dark red, glistening needles with remarkable yellow lustre. *Hexamethylacridine dichromate*, $(C_{19}H_{21}N)H_2Cr_2O_7$, deep red crystals. The *sulphate*, *hydrochloride*, and *nitrite* were also described, as was *ethyl hexamethylacridinium iodide*.

a-Naphthacridine, $(C_{10}H_6)<\overset{CH}{\underset{N}{|}}>(C_{10}H_6)$, pale yellow crystals, m. p. 17°3, sublimes, solutions fluorescent. *Mononitro-a-naphthacridine*, $C_{21}H_{12}(NO_2)N$, m. p. 105—107°. *a-Naphthacridine platinichloride*, $(C_{21}H_{13}N)_2H_2PtCl_6,2H_2O$. *a-Naphthacridine picrate*, $(C_{21}H_{13}N)C_6H_2(NO_2)_3OH$, scarlet needles, m. p. 176—178°. *β-Naphthacridine*,  $(C_{10}H_6)<\overset{CH}{\underset{N}{|}}>(C_{10}H_6)$, yellow needles, m. p. 215·5°, sublimes, solutions fluorescent, identical with β-naphthacridine of Reed. *β-Naphthacridine platinichloride*, $(C_{21}H_3N)_2H_2PtCl_6(H_2O)_2$, yellow powder.

9. "The polymerisation of cyanic acid: cyanuric acid and cyamelide." By A. Senier and T. Walsh.

In the polymerisation of liquid cyanic acid, cyamelide is not the only product. The two isomerides, cyamelide and cyanuric acid, are formed. These may be separated by treatment with water. Pure cyamelide so obtained is soluble in water to the extent of 0·01 per cent. at 15°. The solubility of cyanuric acid at 15° is from 0·145 to 0·16 per cent. Phosphorus pentachloride has no action on cyamelide.

At the next meeting, on Thursday, February 6th, at 8 p.m., the following papers will be read :—

"An investigation into the composition of brittle platinnm." By W. N. Hartley, F.R.S.

"Conversion of 1-hydroxycamphene into β-halogen derivatives of camphor." By M. O. Forster.

"Tetrazoline. Part II." By S. Ruhemann and H. E. Stapleton.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 19, 1902.

Benham, Keith Benham,
Dean's Hill, Stafford.

Student. Research Student in University College Laboratory. Am desirous of obtaining the publications of the Society.

William Ramsay. F. G. Donnan.
Edward C. Cyril Baly. Robert W. Gray.
Edgar Neumann. Morris W. Travers.

Black, Walter Geoffrey,
9, Routh Road, Wandsworth Common, London, S.W.

Student of Chemistry. Studied Chemistry three years at the Central Technical College, obtaining the Diploma of the City and Guilds of London Institute.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. James Moir.
George Harker.

Burrows, Harry,
The Green, Southgate, N.

Chemical Student. A.R.C.Sc. Lond., F.I.C., Ph.D. Heidelberg.

William A. Tilden. Chapman Jones.
W. Palmer Wynne. G. T. Morgan.
M. O. Forster.

Catchpole, Frederick Edward,
11, Jerningham Road, New Cross, S.E.

Student of Chemistry. Engaged in Research Work at the Central Technical College. B.Sc. London University.

Henry E. Armstrong. Edwin C. Jee.
T. Martin Lowry. James Moir.
William A. Davis.

Challen, Matthew Bradbury,

Daylesford, Victoria, Australia.

Director, Daylesford School of Mines. For about four years Assistant at Bairnsdale School of Mines. For several years (*a*) Assayer (*b*) Chemist in charge of Cyanide Works at Stawell. For past three years, and at present, Director of Daylesford School of Mines. Lecturer in Chemistry, Assaying, Metallurgy, &c.

J. Dennant.
A. M. Cameron.
H. W. Potts.
H. T. Waller.
C. R. Blackett.

Chance, Kenneth Macomb,

Lawnside, Edgbaston.

Gentleman. Passed Cambridge B.A. degree in Chemistry. Director of the British Cyanides Co., Ltd., Oldbury.

Alexander M. Chance.
Horace W. Crowther.
H. Wood Smith.
Sidney Williamson.
Charles T. Heycock.
James Dewar.

Clifford, William,

1, Avondale Rd., Wolverhampton.

Chemist and Manager, Sewage Outfall Works, Wolverhampton. Associate of the Royal College of Science, Dublin, in the Faculty of Manufactures.

W. N. Hartley.
J. Holms Pollok.
Hugh Ramage.
W. H. Perkin, jun.
Gilbert J. Fowler.
J. F. Thorpe.
W. T. Lawrence.

Daniels, James Ward,

Westwood, Medomsley, R.S.O., Co. Durham.

Headmaster Westwood Board School, Medomsley. I am a Science Teacher in day and evening schools under S.A. Dept. South Kensington and C.C. Durham. Held Saturday Scholarships for five years at Durham Coll. of Science, Newcastle, and Rutherford Coll. under Dr. Bedson and Messrs. Shaw, Garrett of Coll. of Science, and Mr. Smith of Rutherford Coll. I gained many Adv. certificates under S.K. and Durham Coll., and took 1st. Cl. in Hon. Pract. Chemistry S.K. I am a student of Lond. Univ., and believe the publications of this Society will be helpful.

P. Phillips Bedson.
F. C. Garrett.
Wm. Lewins.
Arthur Crabtree.
Frank R. Dudderidge.

Davis, Frederick,

"Stanley," Whalley, nr. Blackburn, Lancs.

Chemist to the Bingswood Printing Co., Whalley Bridge, nr. Stockport. B.Sc. Vict. (Honrs. Chem.), 1897. Scholar of Vict. University (1897—1898). Associate of Owens College. Tutor in Chemistry, Hulme Hall, Manchester (1897—1898). Chemist to Badische Anilin- & Soda-Fabrik, Ludwigshafen o/Rhine (1898—1901). Student at Owens College (1894—1898).

H. B. Dixon. Wm. A. Bone.
W. H. Perkin, jun. D. L. Chapman.
W. H. Perkin.

Dennis, William,

Ocean Road Pharmacy, South Shields.

Manufacturing and Photographic Chemist. I hold advanced certificates in Mathematics, Theoretical and Practical Chemistry, and being engaged in the manufacture of drugs, &c., am wishful to obtain the Society's publications with a view to keeping in touch with current affairs in Chemistry and Allied Sciences.

Robert McClumpha. *Frank R. Dudderidge.*
James Whittle. *Fredk. Gilderdale.*
Duncan T. Richards. *W. F. Butcher.*
Arthur Payne.

Dixon, John Kemp Smith,

Gothic House, Birstall, nr. Leeds.

Analytical Chemist. Assistant Analyst in the Laboratory of the Yorkshire Wool Combers' Association, Ltd., since July, 1900, under Walter Leach, Esq. Four Sessions (1896—1900) as student (chiefly of Chemistry) at the Yorkshire College, Leeds.

Walter Leach. Julius B. Cohen.
Arthur Smithells. H. M. Dawson.
H. D. Dakin.

Dorée, Charles,

87, Gore Road, London, N.E.

Lecturer in Chemistry, Seafield Park College, Hampshire. Open Natural Science Scholar, Christ Church, Oxford, 1892. B.A., 2nd Class Hons. Chemistry, 1896 ; M.A. 1901. Inter. B.Sc. London University, 1901—1st Class Hons. Chemistry. Science Master Blackburn Grammar School, 1898—1901.

A. Vernon Harcourt. J. E. Marsh.
D. H. Nagel. P. Elford.
H. P. Stevens.

Elsden, Alfred Vincent,

Storrington, Pulborough, Sussex.

Student of Chemistry at University College, London.

William Ramsay.
Edward C. Cyril Baly.
F. G. Donnan.
Morris W. Travers.
Edgar Neumann.
Robert W. Gray.

Eynon, Lewis,

57, Darenth Road, Stamford Hill, N.

Analytical Chemist and Teacher of Chemistry. Chief Chemist to the London Beetroot Sugar Association. Assistant-Demonstrator of Chemistry at the Birkbeck Institute. Co-author of a paper on "Anhydro-Bases" (*Chem. Soc. Journ.*, Oct., 1900). Associate of the Institute of Chemistry.

Raphael Meldola.
John E. Mackenzie.
Thomas H. Pope.
Arthur R. Ling.
F. Southerden.
John R. Brooke.
B. E. R. Newlands.

Fasnacht, Eugène Arthur,

Clayton Mount, Newton Heath, Manchester.

Technical Chemist. Studied Chemistry at the Owens College, and afterwards under Dr. C. A. Burghardt of Manchester. For the last fifteen years Chemist and Manager to Messrs. C. R. Lindsey and Co., Manufacturing Chemists, Clayton, Manchester.

Joseph Gaskell.
Arthur H. Tuer.
H. S. Shorthouse.
Charles Dreyfus.
Harry Silvester.

Ferrier, John Oliver,

Colombo, Ceylon.

Analyst to Colombo Commercial Co., Ltd., Colombo. Attended Chemistry Classes at Heriot-Watt College, and Agricultural Chemistry at Edinburgh University. Over five years Assistant Chemist to Messrs. J. and J. Cunningham, Ltd., Leith, and one and a half years Chemist to the Christmas Island Phosphate Co., Ltd., on Christmas Island.

Samuel Walker.
John S. Ford.
J. Gibson.
J. Falconer King.
William H. Sodeau.

Green, Clarence J., B.Sc.,

24 Dalberg Road, Brixton Church, S.W.

Assistant Chemist in the Government Laboratories, W.C. For three years Student in Owens College. B.Sc. with 1st Class Honours in Chemistry, Victoria, 1898. One year Research Student at Owens College, one year as Priestley Research Scholar at Mason College, Birmingham. Demonstrator in Chemistry at the Owens College six months.

T. E. Thorpe.	W. T. Lawrence.
H. B. Dixon.	J. F. Thorpe.
W. H. Perkin, jun.	Wm. A. Bone.

Haas, Paul,

11, Westbourne Park Road, London, W.

Demonstrator of Chemistry at St. Thomas's Hospital. Clothworker Scholar, 1897. B.Sc. London. First Class Hons. Chem., 1899. Ph.D. Freiburg ¹/B, 1901.

William Ramsay.	Edward C. Cyril Baly.
Arthur W. Crossley.	Robert W. Gray.

F. G. Donnan.

Heaton, Noël,

20, Girdlers Road, W. Kensington.

Technical Chemistry and manufacture of colours. B.Sc. London, Honours in Chemistry. Formerly Student and Exhibitioner of University College, London.

William Ramsay.	J. Nevill Huntly.
Morris W. Travers.	Alex. M. Kellas.
Edward C. Cyril Baly.	F. R. Stephens.

Hennesey, Eugene Edwin, B.A., B.Sc.,

Bigods, Dunmow, Essex.

Principal of the Countess of Warwick's Secondary and Agricultural School, Bigods. Late Assistant in the Chemical Laboratory of the Royal College of Science, London. Teacher of Chemistry in Lady Warwick's School. Has worked at: (1) the bromination of benzil; (2) the estimation of small quantities of alcohol in water; (3) the condensation of acetylene by means of sulphuric acid. No published work.

Raphael Meldola.	W. Palmer Wynne.
William A. Tilden.	G. T. Morgan.

Chapman Jones.

Holdcroft, George Frederick,

253, Oxford Street, Manchester.

Analytical Chemist. Articled pupil for past three years at the Manchester Laboratory under W. Lawrence-Gadd, F.I.C. Have attended practical Course on Organic Preparations, and a Course of Lectures on Physical Chemistry at Owens College, Manchester.

George J. Allen.	*Rowland Williams.*
Harry Bowes.	*M. W. Jones.*
Wm. A. Bone.	

Hurtley, William Holdsworth,

St. Bartholomew's Hospital, London, E.C.

Demonstrator in Chemistry at St. Bartholomew's Hospital and College. Doctor of Science (in Chemistry) of London University. Engaged in teaching Chemistry and Physics at St. Bartholomew's Hospital. Six years as a Student at the Yorkshire College under Professors Thorpe and Smithells. Have published the following papers: (1) "The Chlorodibromo- and the Dichlorobromo-benzenes" (*Trans.*, Dec., 1901); and with Drs. Chattaway and Orton (2) "Notizen über einige Anilide" (*Ber.*, 22, 1900); (3) "Nitrogen Chlorides derivable from *m*-Chloracetanilide" (*Trans.*, 1900, 800).

T. E. Thorpe.	Herbert Ingle.
Arthur Smithells.	F. D. Chattaway.

K. J. P. Orton.

Jackson, William Brannan,

Glengowan, Caldercruix, N.B.

Technical Chemist. Teacher in Chemical Technology. Analytical Chemist in Bleach, Print, and Dye Works for seven years. Teacher in Wool Dyeing, Cotton Dyeing, Calico Printing, &c., at the Glasgow Dyeing and Weaving College. Registered Teacher under the City Guilds London Institute in Dyeing, Calico and Linen Bleaching and Printing.

Peter B. Scotland.	*George H. Hurst.*
C. F. Seymour Rothwell.	*Jas. Grant.*
Jul. Hübner.	*L. G. Radcliffe.*

Jardin, David S. Smith,

Rathgar House, Rathgar.

Associate of the Royal College of Science, Dublin. Associate of the Institute of Chemistry. Licentiate of the Pharmaceutical Society of Ireland. Temporarily assisting in the Laboratory of the Royal College of Science, Dublin.

W. N. Hartley.	J. Holms Pollok.
W. E. Adeney.	Hugh Ramage.

Chas. R. C. Tichborne.

Lavelle, Selwyn Philip James,

Royston Villa, Ashby Road, Burton-on-Trent.

Brewer's Analyst. Studied Chemistry under Dr. Percy Frankland for two years at the Mason College, Birmingham, and passed the term examination, and have since studied the Chemistry of Brewing for six months under Matthews and Lott, Burton-on-Trent, and after that I have been occupied for the past two years as Assistant Chemist at Messrs. Worthington and Co., Ltd., Burton-on-Trent.

Chas. Geo. Matthews.	C. O'Sullivan.
W. Taverner.	Percy F. Frankland.

Adrian J. Brown.

Lucas, Harry,

1, St. Agnes' Place, Kennington Park, S.E.

Demonstrator in Chemistry at the Metropolitan College of Pharmacy First Prizeman Advanced Practical Chemistry, Cardiff Science and Art Schools, Session 1887—1888. Passed Major Exam. Pharmaceutical Society, Xmas, 1895. For past 5½ years Lecturer in Pharmacy and Demonstrator in Organic and Analytical Chemistry.

W. Watson Will.	H. A. D. Jowett.
Peter MacEwan.	F. Filmer De Morgan.
F. B. Power.	Thomas Tyrer.

Ludlam, Ernest Bowman,

University College, Bristol.

Demonstrator of Chemistry. Honours B.Sc. (Vict.) in Chemistry, and Leblanc Medal, 1900. Subscriber to Journal and Proceedings, and desirous of keeping in touch with advances in Chemistry.

J. Campbell Brown.	Charles A. Kohn.
Sydney Young.	J. Norman Collie.

W. Collingwood Williams.

Mackenzie, John Ross,

31, Bailey Street, Ton-Pentre, Glam.

Head Brewer, Maltster, and Chemist. Thirteen years' experience as such in Scotland, England, and Wales. Three years' Student of Chemistry under A. Price, B.Sc. (Lond.). Silver Medallist in Brewing, Boston, England. Member of Institute of Brewing, London. Honours Certificates in Brewing, City and Guilds of London Institute. At present Head Brewer to Messrs. D. John & Co., Limited, Pentre, Glam.

Basil P. Wigan.	*Edward Haworth.*
W. T. Leeming.	*Edward J. Russell.*
J. Jackson.	*Laurence Briant.*
Thomas Mackenzie.	*Walter Howe.*

Maitland, William, B.Sc.,
236, Brookhill, Sheffield.

Junior Demonstrator of Chemistry, University College, Sheffield. Lately Junior Assistant, Chemical Department, University of Aberdeen. At present Junior Demonstrator, University College, Sheffield. Have been engaged, with Professor Japp, in a research on a new synthesis of carbazoles, a preliminary note of which has appeared in the *Proceedings* of the Chemical Society (June 20th, 1901).

W. Carleton Williams. George Young.
F. R. Japp. Wm. B. Davidson.
T. S. Murray.

Martin, Francis,
64, Samuel St., Woolwich.

First Assistant Analytical Chemist, Messrs Siemens Bros. & Co., Ltd. (Woolwich). Training in Practical and Theoretical Inorganic and Organic Chemistry, also Metallurgy, at the Woolwich Polytechnic. Honours pass and prizes in the former, and certificates in the latter, conducted by Mr. J. B. Farlie, F.C.S., &c. Ten years' experience in a Chemical Laboratory, and position as first assistant for the last two years. Assisting the late Dr. E. Obach, F.I.C., F.C.S., in the preparation of his Cantor Lectures on Gutta Percha (see footnote of reprint, p. 82).

W. F. Eichenauer. Lionel M. Jones.
J. B. Farlie. *Chas. R. Darling.*
Charles T. W. Hirsch.

Molesworth, Francis Hylton,
Turramurra, Sydney, New South Wales.

Analytical Chemist, Lecturer in Chemistry, Govt. Technical College, Sydney. Formerly Student, Owens College, Manchester. Lecturer in Chemistry, Geology, &c., to South Australian Govt., now Lecturer in Chemistry at Government Technical College, Sydney.

L. R. Scammell. G. A. Goyder.
Andrew Thomas. *Alexander Orr.*
J. C. Fraser.

Mundey, Alfred Holley,
17, St. Margaret's Road, Plumstead.

Chemist. Senior Assistant Chemist and Metallurgist, Royal Carriage Department, Royal Arsenal. Assistant Lecturer in Chemistry and Metallurgy, Woolwich Polytechnic. Pupil of Mr. J. B. Farlie, F.C.S., &c., appointed Assistant in 1888, and still working under his direction at Royal Arsenal and Polytechnic.

J. B. Farlie. *W. H. Deering.*
Lionel M. Jones. *T. H. Dodd.*
Chas. R. Darling. *Oliver Trigger.*

Ogilvie, Allan,

19, Market Street, Millom, Cumberland.

Analytical Chemist. I was seven years in the laboratory of Messrs. R. R. Tatlock and Thomson, City Analysts, Glasgow; 6 years as student and assistant, and 1 year in charge of Students' Department. I left there to become Senior Chemist at Millom Iron Works, where I have been employed for the last 2½ years.

R. R. Tatlock. A. Humboldt Sexton.
R. T. Thomson. Horatio Ballantyne.
Jas. D. Dougall.

Panisset, Sydney Glyde Stephen,

7, Jersey Road, Strood, Rochester.

Analytical Chemist. Associate of the City and Guilds of London Institute. Late Assistant to Mr. C. E. Groves (Consulting Chemist to the Thames Conservancy). Chief Chemist at Wickham Cement Works, Rochester.

Charles E. Groves. Henry E. Armstrong.
Herbert F. Stephenson. Gerald T. Moody.
D. B. Butler. R. Meldola.

Ross, William Charles,

27, Pitt Street, Edinburgh.

M.B., Ch.B., D.P.H. One session Edinburgh University, Theoretical and Practical Chemistry. One year devoted to analysis of foods, drugs, and water at Messrs. Tatlock and Readman's Laboratory, Edinburgh.

Alex. Crum Brown. G. H. Gemmell.
Hugh Marshall. *Leonard Dobbin.*
W. Ivison Macadam.

de la Rue, Evelyn Andros,

52, Cadogan Square, London.

A Director of Thos. de la Rue and Co. Late Student of Chemistry at Trinity College, Oxford. B.A. in Chemistry, Second Class in Honour School (June, 1901).

Hugo Müller. A. Vernon Harcourt.
Harold Hartley. D. H. Nagel.
Allan F. Walden.

Sidgwick, Nevil Vincent,

Lincoln College, Oxford.

Fellow and Lecturer in Chemistry. M.A. First Class in Final

Chemical School, 1895. D.Sc. Tübingen, 1901. Dissertation "Ueber Acetondipropionsäure und ihre Derivate."

D. H. Nagel.	A. Vernon Harcourt.
Harold Hartley.	W. H. Mills.
G. W. F. Holroyd.	Allan F. Walden.

Sinnatt, Frank Sturdy,

Glenside, Church Lane, Moston, Manchester.

Assistant Lecturer and Demonstrator in Chemistry at the Municipal School of Technology, Manchester. Completed the three years Chemistry Courses in the above School, and have passed several subjects in the Honours Stage (Board of Education and City Guilds). My reason for wishing to join the Society is to obtain its publications to assist in research work.

William J. Pope.	L. G. Radcliffe.
Jas. Grant.	William Dixon.

Daniel McLaren.

Smith, Robert Eley Blake,

93 Upper Richmond Road, Putney, S.W.

At present Research Student at University College, London. B.Sc. (Lond.), A.I.C. I desire to attend the meetings of the Society and to obtain its publications.

William Ramsay.	F. G. Donnan.
Edward C. Cyril Baly.	Edgar Neumann.
Morris W. Travers.	Robert W. Gray.

Southworth, William,

County Council Farm, Hutton, Preston, Lancs.

Assistant Lecturer in Agriculture and Superintendent of experiments to the Lancs. County Council. Three years' training (day classes) in General and Agricultural Chemistry and in General Science, Harris Institute, Preston. Hons. Certif. Science and Art Dept. in Agricultural Chemistry and Analysis. Four years Assistant Lecturer on Agriculture; and Superintendent of Field and Manurial experiments to the above Council.

George McGowan.	C. Gerland.
Frank T. Addyman.	John B. Coppock.

J. A. Gardner.

Stead, Francis Bernard,

Clifton College, Bristol.

Assistant Master Clifton College. Formerly Science Scholar at

King's College, Cambridge, and Science Master at Aldenham School. First Class in Nat. Sci. Tripos, Parts I and II, 1894—1895.

W. H. Shenstone.	H. J. H. Fenton.
C. T. Heycock.	W. J. Sell.

J. E. Purvis.

Swain, James,

17, Winsham Street, West Side, Clapham Common, S.W.

Teacher of Chemistry. Wish to avail myself of the Library and Publications of the Society. Reading for Final B.Sc. (Lond.).

W. B. Hards.	Frank E. Weston.
B. C. Polkinghorne.	Robert Steele.

Thos. W. Berry.

Turner, Lyon Viccars,

Crescent Lodge, St. John's, S.E.

Student of Chemistry. Studied Chemistry for 2 years at the Central Technical College, and have since been engaged in Research Work.

Henry E. Armstrong.	Gerald T. Moody.
William A. Davis.	James Moir.

Arthur Lapworth.

Webb, Arthur James,

21, Hammelton Road, Bromley, Kent.

B.A., Oxford. Exhibitioner in Chemistry at Magdalen College, Oxford. Interest in the Study of Chemistry. Final Honours in Chemistry, Oxford.

Henry A. Miers.	V. H. Veley.
Duncan R. Wilson.	J. E. Marsh.
W. W. Fisher.	H. Brereton Baker.

Womersley, Charles Edward,

Kilpin Hill, near Dewsbury (Yorks).

Teacher of Chemistry under Board of Education. Chemistry, Honours, South Kensington. For three years Assistant Chemistry Master, Organised Science School, Heckmondwike. At present Chemistry Master, Technical School, Cleckheaton.

R. S. Cahill.	Arthur Peacock.
James Foulds.	T. W. Lockwood.

Arthur Crabtree.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 246.

February 6th, 1902. Dr. ARMSTRONG, Vice-President, in the Chair.

Messrs. E. L. Sherwood and A. G. Aston were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Frederic Guy Stirling Baker, Marryatts Lodge, Snaresbrook, Essex; Richard Blenkinsop, Garden Wharf, Battersea, S.W.; Alexander Bruce, 10, Portland Terrace, Plumstead, S.E.; Fred Carrodus, Glen Fern Tower, Lansdowne Road, Wimbledon, S.W.; James Codrington Crocker, 2, Flynore Villas, Swansea; Gilbert Gunn, 209, Rochdale Road, Bury, Lancs.; Frank Eustace King, Woodbury, Polworth Road, Streatham, S.W.; A. Lionel Landau, 20, Highbury New Park, N.; Charles Henry Lockitt, 5, Harley Road, S. Hampstead, N.W.; Walter Ramshaw, 5, Fronwen Terrace, Brecon; William Scholes, 151, Ainsworth Road, Radcliffe, Lancs.; Arthur Lea Butler Tindall, 41, Sunnyside Road, Ilford; Edward John Wilkinson, 8, Blenheim Terrace, Leeds; Thomas A. Young, 318, Chetham Hill Road, Manchester; Cecil Revis, 77, King Street, West Hammersmith, W.

Of the following papers, those marked * were read:

*10. "Conversion of 1-hydroxycamphene into β-halogen derivatives of camphor." By M. O. Forster.

β-Bromocamphor, obtained by the action of bromine on 1-hydroxycamphene (*Proc.*, 1901, **17**, 245), yields camphor when reduced with zinc dust and acetic acid, and is hydrolysed by alcoholic potash, forming α-campholenic acid. The oxime remains indifferent to alcoholic potash, and is not converted into a nitrile under the influence of mineral acids; it yields a *benzoyl* derivative which crystallises from alcohol in silky needles melting at 71—73°.

β-Chlorocamphor, $C_{10}H_{15}OCl$, prepared from 1-hydroxycamphene and chlorine in acetic acid containing sodium acetate, crystallises from alcohol in long, slender prisms melting at 132·5°; it has $[\alpha]_D = +39{\cdot}5°$ in chloroform, and $[\alpha]_D = +40{\cdot}7°$ in alcohol. The *oxime* is isomorphous with β-bromocamphoroxime, and melts at 134°; the *benzoyl* derivative crystallises in silky needles melting at 86°.

β-Chloro-α-bromocamphor, $C_{10}H_{14}OClBr$, produced by the action of bromine on β-chlorocamphor, crystallises from petroleum in tabular aggregates of white prisms, and melts at 101°; it has $[\alpha]_D = +126{\cdot}5°$ in chloroform.

The *methyl ether* of 1-hydroxycamphene, $C_{10}H_{15}{\cdot}OCH_3$, formed when the hydroxy-compound is heated with methyl iodide and dry silver oxide, is a colourless, limpid oil which boils at 193—194°, has sp. gr. 0·9314 at 20°, and $[\alpha]_D = -27{\cdot}3°$. The *ethyl ether*, $C_{10}H_{15}{\cdot}OC_2H_5$, resembles the lower homologue, and boils at 203—204°; bromine converts it into β-bromocamphor.

*11. "The influence of temperature on association in benzene solution and the value of the molecular rise of boiling point for benzene at different temperatures." By W. R. Innes, M.Sc., Ph.D.

The molecular rise of boiling point at different temperatures was determined by introducing phenanthrene, benzophenone, and benzil into benzene, boiling under reduced, atmospheric, and increased pressure. A constant pressure was maintained during each series of experiments at reduced or increased pressure by means of an automatic electrically controlled regulator. The molecular rise of boiling point (τ) was also calculated (*a*) from the heat of vaporisation by means of van't Hoff's formula, $100\tau = RT^2/L$ (calculated *A*) and (*b*) from the rate of change of vapour pressure with temperature by means of the equation $100\tau = Mp\Big/\frac{dp}{dt}$ in which M is the molecular weight of benzene and p the mean pressure (calculated *B*). The calculated molecular rise and the mean experimental values found for concentrations up to 6/100 gram-molecules per 100 grams benzene are given in Table I:

TABLE I.

Temperature.	54°.	58°.	63°.	73°.	80°.	3°.
Calculated A ...	21·6	22·2	23·0	25·0	26·5	29·5
Calculated B ...	21·05	21·6	22·4	24·25	25·5	27·8
Phenanthrene ...	21·0	—	22·4	23·55	25·25	27·3
Benzophenone ...	20·17	—	21·6	23·0	23·8	26·2
Benzil	—	21·0	—	—	23·3	26·24

The molecular rise calculated from the heat of vaporisation is greater than that calculated from the vapour pressure, the difference increasing with increase of temperature. The values found, using phenanthrene as the dissolved substance, agree very closely with those calculated from the rate of change of vapour pressure. The closely related substances benzophenone and benzil give numbers for the molecular rise which are almost identical. The molecular rise for benzophenone is about 0·8 less than that for phenanthrene at the same temperatures.

Series of determinations were carried out at different temperatures with the abnormal substances benzoic acid, *o*-bromobenzoic acid, *β*-benzil monoxime and dimethyl tartrate. It was found that the dissociation of the complex molecules increased with the temperature between 54° and 80° in every case. Between 80° and 93° there was an apparent decrease of dissociation at all concentrations with benzoic acid and *β*-benzil monoxime; *o*-bromobenzoic acid and dimethyl tartrate were more dissociated at 93° in dilute solutions, but in more concentrated solutions the molecular weights became equal to those at 80° with the former substance and greater with the latter.

The heats of dissociation (Q gram calories) of *β*-benzil monoxime, *o*-bromobenzoic acid and benzoic acid were calculated from the molecular weights at different temperatures and found to be of the same order as those of a number of typical dissociating gases. Table II gives the values calculated; V is the volume in litres occupied by the benzene in which 1 gram-molecule of the substance, calculated as double molecules, is dissolved:

TABLE II.

Substance.	T_1.	T_2.	V.	Q.
β-Benzil monoxime	278	331	13	14600
,, ...	331	353	14	19900
o-Bromobenzoic acid......	331	353	8·18	7500
,, ...	331	353	12·3	5300
Benzoic acid	336	353	8·18	22800

The heat of dissociation of nitrogen tetroxide is 28900 cal., iodine vapour 28500 cal., acetic acid 20000 cal. and dimethyl ether hydrochloride 8600 cal.

DISCUSSION.

In reply to questions by Dr. TRAVERS, Dr. INNES said that several series of determinations of the molecular rise of boiling point were made; there was very satisfactory agreement in every case. The series with abnormal substances at 93° was not repeated, but the fact that the molecular weight of all four substances was higher than might have been expected seemed to show that the anomalous results at this temperature are not due to ordinary experimental error, whilst from the values obtained for the molecular rise of boiling point it appears that they are not due to a constant error in the method.

*12. "The magnetic rotation of ring compounds; camphor, limonene, carvene, pinene and some of their derivatives." By W. H. Perkin, sen., Ph.D., F.R.S.

The remarkable differences between the magnetic rotations of saturated *closed* chain or ring compounds, such as the derivatives of tri-, tetra-, penta- and hexa-methylene, and the open chain compounds of the aliphatic series, both unsaturated and saturated, were first referred to, the ring compounds having a *much lower* rotation than those which have unsaturated open chains, but the *same* composition; their rotation is also *smaller* than that of the saturated open chain compounds from which they differ in composition by $-H_2$.

On comparing the magnetic rotation of the mono- and di-carboxylic acids and ketones of the closed chain compounds with those of the corresponding saturated open chain aliphatic compounds containing the same number of carbon atoms, considerable discrepancies were observed in the amounts by which they differ from each other, which range from about 0·33 to 0·64, and this want of accord has hitherto been an enigma, but it is now found that this is due to the comparisons having been made between the wrong members of the two series. If tri-, tetra-, penta- and hexa-methylene be taken as the first, second, third and fourth members of the series, as they undoubtedly are, and are compared with the first, second, third and fourth members of the aliphatic series, allowing for the difference of composition, $(CH_2)_3$, these discrepancies disappear. The differences between the rotations of these series are then found to be nearly uniform, and amount to about $-0·60$ in the mono- and di-carboxylic acids, ketones, and monochloro-derivatives of hexamethylene. In the ring hydrocarbons, this difference is, however, much larger, amounting to about 0·988.

The next point considered was the influence of the double or *bridged ring* formation, in which the ring formation from the open chain compound has taken place twice, and therefore with a loss of four atoms of hydrogen. Camphor is a compound of this class, and it was found in its case that the bridged ring affected the rotation to the extent of $-1{\cdot}290$, or a little more than twice that of the single ring. In borneol, an analogous result was obtained, whilst menthol, which contains only a single ring, gave an amount analogous to the synthetical ring compounds.

Camphene also contains a bridged ring, which is unsaturated, and after allowing for this, it gives a difference of $-1{\cdot}337$, which is not very different from that of camphor. The magnetic rotation of pinene, which is isomeric with camphene but differs from it somewhat in the character of the bridged ring, gave results very similar to those of the latter, but which are a little higher.

In the case of the limonenes, which also are isomeric with camphene but contain only a single unsaturated ring along with the unsaturated group $CH_3{\cdot}\underset{|}{C}{:}CH_2$ outside the ring, the rotations are very different, the value of the single ring formation, allowing for unsaturation, being practically the same as in hexamethylene, 0·988.

The rotations of chlorine and bromine derivatives of camphor and the relationships of nitro- and pseudonitro-camphor and camphoryloxime were considered, as well as the rotation of camphylamine, bornyl chloride or pinene hydrochloride and dipentene dihydrochloride.

The refraction values of borneol and camphor and its derivatives were also given.

*13. "The transport number of very dilute solutions." By B. D. Steele, B.Sc., and R. B. Denison, B.Sc.

The object of this research was to see if it were possible to obtain by the investigation of sufficiently dilute solutions a value for the transport number for solutions of salts such as calcium chloride, which would result in a constant specific ionic velocity when calculated from different salts of the same cation, thus bringing these salts into line with others, such as potassium chloride, to the ions of which definite specific velocities can be assigned. In order to test this question, it was first necessary to develop a method by means of which the transport number could be determined for very dilute solutions. The method employed is a simple modification of that originally used by Hittorf and lately modified by Noyes ; it permits of the electrolysis of a practically unlimited volume of solution being carried out in a vessel of reasonable size.

Measurements have been made for calcium chloride, nitrate and sulphate, and for potassium chloride, in concentrations of one gram equivalent in 250 litres; and, by combination of the transport numbers found with the conductivity at infinite dilution, identical values are obtained for the velocity of the chlorine ion from solutions of the calcium and potassium salts, and for the calcium ion from solutions of the chloride and nitrate. The velocity of the calcium ion calculated from measurements of calcium sulphate solution is, however, about 3·5 per cent. higher. The transport number of potassium chloride agrees with the best determinations made in solutions up to 1/10 normal, and confirms Kohlrausch's assumption that this remains constant with further dilution.

*14. "An investigation into the composition of brittle platinum." By W. N. Hartley, D.Sc., F.R.S.

Having had to report upon the composition of brittle platinum in the form of fragments of pins used for dental purposes, their average weight being under 20 milligrams each, a description was given of the method by which the absence of metallic impurities, and also of silicon, was proved spectrographically. The brittle and crystalline character of the metal was shown to be in all probability caused by minute quantities of phosphorus or carbon, and by remelting in a lime crucible under the oxyhydrogen flame its malleability was greatly improved, thus confirming the accuracy of the conclusion arrived at.

The difficulty in deciding beyond question whether there were iron lines in the platinum, or platinum in the iron spectrum, or lines of some impurity common to both metals was pointed out, as showing the importance for practical purposes of determinations of wave-lengths made with the greatest accuracy attainable, particularly in the case of such spectra as these where large numbers of lines are so closely grouped together as to have approximately the same wave-lengths.

15. "Tetrazoline. Part II." By S. Ruhemann and H. E. Stapleton.

The authors find that the action of methyl iodide on tetrazoline is complicated, and they described two of the substances which are formed. One of them crystallises in dark blue needles having the formula $C_3H_9N_4I_3$, and is readily decomposed by water with separation of iodine, whilst the other forms colourless, well-developed crystals, and is an iodide of the formula $C_3H_7N_4I$, which may be transformed into the corresponding chloride and into the platinichloride, $(C_3H_7N_4)_2H_2PtCl_6$. The authors gave reasons for their view that this iodide (or the chloride) is not the salt of methyl tetrazoline; their work, however, is not yet advanced enough to fix the constitution of those two compounds, or to explain the reaction by which they are formed.

16. "The solubilities of the calcium salts of the acids of the acetic acid series." By J. S. Lumsden, D.Sc., Ph.D.

It is well known that many calcium salts diminish in solubility with increase of temperature, and in order to obtain further information on this subject the solubilities of the salts of the acids of the acetic acid series have been carefully determined.

Calcium formate is anhydrous when in contact with its saturated solution and gives a simple ascending curve of solubility. The calcium salts of the other acids of the series contain water of crystallisation and all diminish in solubility with rise of temperature until a minimum point is reached, after which the solubility increases.

Of the salts of the normal acids only calcium acetate changes from one crystalline state to another between 0° and 100°, whilst both calcium *iso*butyrate and calcium *iso*valerate have double curves. With the exception of calcium formate all the salts which have been examined, when in contact with their saturated solutions at 100°, consist of crystals which contain 1 molecule of water.

The salts of the normal acids increase in solubility from formate to acetate and propionate, then decrease quickly with the growth in the number of carbon atoms, the salts of the *iso*-acids being more soluble than those of the corresponding normal acids.

17. "The equilibrium between a solid and its saturated solution at various temperatures." By J. S. Lumsden, D.Sc., Ph.D.

The solubilities of the calcium salts of the acids of the acetic acid series were found to be all represented by curves convex to the temperature axis, indicating at first decrease then increase of solubility.

A curve of this shape is in no way anomalous, for by considering the action of heat on each of the factors which condition the equilibrium in a saturated solution, it is seen to be typically a normal curve.

The factors which produce equilibrium in a saturated solution are: the affinity between solid and solvent, the thermal energy of the solid and the pressure of the dissolved particles. By resolving the solubility curve, which is an exact representation of the resultant of these forces at different temperatures, into component curves representing the forces, the influence of temperature on each can be studied.

When each force varies directly as the temperature, the solubility curve is a straight line; when the rate is different it is a curve convex to the temperature axis.

Some experimenters have given curves of solubility concave to the temperature axis, but examination of several curves of that kind has shown that they have been produced by the joining of points on two convex curves, so cutting out the transition point.

By estimating the heat of solution at two points on a convex curve where the solubility is the same, it was found that the sensible heat was much less at the higher point. It was also found that the heat of solution at any temperature diminishes with the concentration, and that the direction of the solubility curve indicates the heat of solution in a saturated solution only, being positive on a descending and negative on an ascending curve.

18. "On the union of hydrogen and chlorine. Part IV. The Draper effect." By J. W. Mellor and W. R. Anderson.

The momentary expansion which occurs when a mixture of equal volumes of hydrogen and chlorine is exposed to a flash of light is called, after its discoverer, the Draper effect.

This phenomenon is only produced when luminous rays impinge upon a mixture of approximately equal volumes of hydrogen and chlorine, but not upon chlorine alone, either under reduced or under ordinary pressures, or at temperatures between 15° and 100°. It is not produced when chlorine is mixed with steam, air, nitrogen, carbon dioxide, carbon monoxide, or methane. When the effect reaches a certain magnitude the mixture explodes. Although a few sparks bring about no measurable combination of the mixed gases, the joint effects of a great number of sparks at intervals of half an hour or of one hour is measurable, thus showing that chemical combination takes place during the Draper effect. The amount of combination depends not only upon the number but also upon the intensity of the sparks. The Draper effect appears to be due to some disturbance in the gas which attends chemical combination.

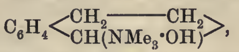
19. "Note on the constitution of certain organic nitrates." By C. R. Marshall and J. H. Wigner.

The authors criticise a theory recently advanced by Vignon and Gerin regarding the constitution of mannitol hexanitrate and allied substances. According to the French chemists, these higher nitrates reduce Fehling's solution strongly, whereas the lower nitrated compounds such as glycerol trinitrate have no reducing action whatever. In order to explain this they state that the terminal $-CH_2\cdot OH$ group of the higher polyhydric alcohols is converted, during nitration, into a hydrated aldehyde group, $-CH(OH)_2$, which, under the influence of the nitrous acid formed during the reaction, is further changed to a $-CH(OH)ONO$ group. This, by the action of the alkali of the

Fehling's solution, is converted to an aldehyde group which acts as the reducing agent.

Against this view it is urged that the amount of nitrite formed during hydrolysis would vary considerably in the different members of the series, which is shown not to be the case. It is further proved that these compounds possess only a slight reducing action which can be explained on other grounds. The authors see no reason for departing from the view that these substances are nitric acid esters of the various alcohols.

20. "**Resolution of trimethylhydrindonium hydroxide into its optically active components.**" **By F. S. Kipping.**

In continuing his work on hydrindamine (*Trans.*, 1900, 77, 861; 1901, 79, 370, 430, and 442) the author has studied some of the salts of trimethylhydrindonium hydroxide,  $C_6H_4<\begin{matrix}CH_2\text{———}CH_2\\ CH(NMe_3\cdot OH)\end{matrix}>$, in order to compare their behaviour with that of the salts of the parent base.

dl-Trimethylhydrindonium iodide (*Trans.*, 1900, 77, 469) interacts with silver *d*-bromocamphorsulphonate, giving dl-*trimethylhydrindonium* d-*bromocamphorsulphonate*, which can be separated into different fractions by crystallisation from a mixture of chloroform and ethyl acetate.

The most sparingly soluble fractions yield d-*trimethylhydrindonium* d-*bromocamphorsulphonate*, $C_{12}H_{18}NO\cdot SO_2\cdot C_{10}H_{14}BrO$; it crystallises in slender needles, melts at 199—200°, and in dilute aqueous solution $[\alpha]_D = +70°$.

d-*Trimethylhydrindonium iodide*, $C_{12}H_{18}NI$, prepared from the preceding salt, crystallises from water in lustrous needles, decomposes at about 190° and is very different from the racemic iodide in most respects; its specific rotation in dilute aqueous solution is $[\alpha]_D = +21{\cdot}9°$.

These results show that hydrindamine and trimethylhydrindonium hydroxide behave very differently towards one and the same acid.

21. "**Resolution of methylbenzylacetic acid into its optical isomerides.**" **By F. S. Kipping.**

Methylbenzylacetic acid, $C_6H_5\cdot CH_2\cdot CHMe\cdot CO_2H$ (α-methylhydrocinnamic acid), contains an asymmetric carbon group, is easily obtained in large quantities and has recently been used for the preparation of methylhydrindone (*Proc.*, 1901, **17**, 181); in order to obtain an optically active acid chloride for various purposes indicated in the following note, the resolution of the acid was attempted.

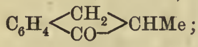
Fractional crystallisation of the quinine salt gave the desired result; the salt of the *d*-acid is the more sparingly soluble in most solvents, and, after repeated crystallisation from dilute alcohol and ethyl acetate, is obtained apparently free from its isomeride.

Quinine d-*methylbenzylacetate* crystallises in prisms, melts at 118—119° and is very readily soluble in warm alcohol, but only sparingly so in boiling water; it has a specific rotation $[\alpha]_D = -113°$ in ethyl alcoholic, and $[\alpha]_D = -76°$ in ethyl acetate, solution.

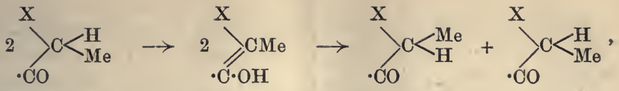
d-Methylbenzylacetic acid is an oil at ordinary temperatures; the highest specific rotation which has been observed with different samples of the acid (without solvent) is $[\alpha]_D = +20·3°$. The sodium salt, purified by fractionally precipitating its alcoholic solution with ether, crystallises in colourless plates and has a specific rotation $[\alpha]_D = +26°$ in dilute aqueous solution.

The chloride, prepared by treating the *d*-acid with phosphorus pentachloride and distilling under reduced pressure, is optically active, but probably contains considerable quantities of the *l*-isomeride owing to partial racemisation having occurred.

22. "*d*-Methylhydrindone. The formation of oximes, hydrazones, and semicarbazones." By F. S. Kipping.

When the optically active methylbenzylacetyl chloride described in the preceding note is treated with aluminium chloride under suitable conditions (*Proc.*, 1901, **17**, 181) it yields an optically active methylhydrindone,  $C_6H_4{<}\genfrac{}{}{0pt}{}{CH_2}{CO}{>}CHMe$; the specific rotation of the crude product, which is probably a mixture of the *d*- and *l*-isomerides, is about $[\alpha]_D = +25°$ in methyl alcohol.

The optical properties of the ketone seem to undergo no change at the ordinary temperature, so that it consists entirely of the keto-form; in accordance with this conclusion, it does not give a coloration with ferric chloride. When heated at its boiling point under the ordinary pressure for some time the ketone racemises, doubtless owing to keto-enolic isomeric change. It also racemises when treated with small quantities of sodium methoxide, sodium hydroxide, or sodium carbonate in alcoholic solution, and the gradual change in rotation can be followed with the polarimeter. There can be little doubt but that this racemisation is brought about by a keto-enolic transformation.



and these observations afford direct experimental evidence in favour of the accepted views regarding such changes.

Methylhydrindone and hydroxylamine do not seem to interact in absence of alkali, but in presence of potassium hydroxide oxime formation occurs rapidly; the oxime obtained from the *d*-ketone is optically inactive. The *d*-ketone interacts with phenylhydrazine in acetic acid solution, giving a hydrazone; in this reaction also an optically inactive product is obtained. These facts seem to show that oxime and hydrazone formation are preceded by the conversion of the keto- into the enolic form.

When the active ketone is treated with semicarbazide hydrochloride and sodium acetate in aqueous alcoholic solution it yields an optically inactive and an active semicarbazone; the former is probably produced owing to the presence of the *l*-ketone in the original substance, and the formation of an active product seems to show that in semicarbazone formation there is no previous transformation of the keto- into the enolic modification. These and other reactions of ketones are being further investigated.

23. "Optically active methylbenzylacetic acid." By A. Lapworth and W. H. Lenton.

In order to obtain further evidence on the question as to whether α-substitution in acids and ketones is the result of direct replacement of the hydrogen atom or is preceded by the formation of an ethylenic compound with the group $\cdot\dot{C}\colon\dot{C}\cdot O\cdot$, attempts were made to prepare an optically active acid which would undergo racemisation if the latter view were the correct one. For this purpose, methylbenzylacetic acid was thought to be the most convenient substance, as it is easily synthesised and in its usual form is a solid at the ordinary temperature; the quinine salt of the acid was therefore fractionally crystallised from ethyl acetate until the melting point and specific rotation of the least soluble portions remained constant.

Quinine d-*methylbenzylacetate* crystallised from ethyl acetate in well-formed needles which melted at 117°.

d-*Methylbenzylacetic acid*, $CH_2Ph\cdot CHMe\cdot CO_2H$, is a colourless oil; its specific rotation in 1 per cent. ethyl acetate solution was $[\alpha]_D = +14{\cdot}9^\circ$. The *ethyl* ester, under similar conditions, has $[\alpha]_D = +13{\cdot}2^\circ$.

The active acid does not racemise appreciably at temperatures below 130°, but when its chloride is brominated at 80—90°, the product is optically inactive.

As the authors learn from Dr. Kipping that he has been engaged on the study of active derivatives of benzylmethylacetic acid, they propose to leave its further investigation in his hands.

The following additional Candidates have been proposed for election. A ballot will be held on Wednesday, February, 19, 1902, at 5.30 p.m.

Ferrand, Frederick,

13 Torrington St., Hopwood, Heywood.

Works Manager, Heywood, Lancashire. For 17 years Assistant Manager of a wholesale Manufacturing Chemist, Manchester. Now Manager of the Tallow, Oil and Soap Works of Messrs. Hartley and Co., Heywood. A Chemical Research Student.

Evan Williams.	*L. G. Radcliffe.*
Jas. Grant.	*William Dixon.*
Ernest Scott.	*Daniel McLaren.*

The following Certificate has been authorised by the Council under Bye-law I, (3).

Buxy, Tarit Kanti, M.A.,

Jubbulpur, C. P., India.

Professor of Chemistry, Government College, Jubbulpur. Junior Scholar, Entrance Examination, 1890 (Calcutta University) and First in Behar Circle. Senior Scholar, First Arts Examination, 1892, and Second in the University in order of merit. Honours in Mathematics, Physics, and Chemistry in the B.A. in 1894, and Foundation Scholar, Presidency College, Calcutta. Worked in the Presidency College Laboratory under Professors A. Pedler, F.R.S., P. C. Rây, D.Sc. (Edin.), and P. Mukherjee, B.Sc., (Lond.), and stood first in the University in M.A. in Chemistry.

Alex. Pedler.	*Chuni Lal Bose.*
J. Bhaduri.	*H. E. Stapleton.*

ADDITIONS TO THE LIBRARY.

I. By Donation.

Berzelius, J. J. Lehrbuch der Chemie. Aus der schewidischen Handschrift des Verfassers übersetzt von F. Woehler. Vierte Original-Auflage. 1835. 10 vols. From E. W. Prevost.

Church, A. H. Food-grains of India (Supplement). Containing analyses made since the year 1886. Pp. 23. 1901. From the Author.

Gowland, William. The early metallurgy of silver and lead. Part I. Lead. Pp. 64. 1901. From the Author.

Halliburton, W. D. The Croonian lectures on the chemical side of nervous activity. Pp. 99. London 1901. From the Author.

Roscoe, Henry Enfield, and Schorlemmer, C. Ausführliches Lehrbuch der Chemie. 9 vols. Braunschweig 1885—1902. From Sir Henry Roscoe.

Jahresbericht über die Fortschritte der physischen Wissenschaften. Von Jacob Berzelius. Aus dem schwedischen übersetzt von C. G. Gmelin (later) und F. Wöhler. 20 vols. 8vo. Tübingen. 1822—1841.

(Continued under the title):

Jahresbericht über die Fortschritte der Chemie und Mineralogie. Eingereicht an die schwedische Akademie der Wissenschaften. Von Jacob Berzelius. (From 1849—1851. Edited by L. F. Svanberg.) Aus dem schwedischen übersetzt von F. Wöhler. 10 vols. (xxi—xxx). 8vo. Tübingen 1842—1851. Register, i—xxv. 1847. From Sir Henry Roscoe.

Kurzes Lehrbuch der Chemie, nach den neuesten Ansichten der Wissenschaft. Braunschweig 1898. From Sir Henry Roscoe.

Ostwald's Klassiker der exakten Wissenchaften. Photochemische Untersuchungen. 1892. From Sir Henry Roscoe.

Jahresbericht über die Fortschritte der chemischen Technologie für Fabrikanten, Hütten- und Forstleute, Cameralisten, Chemiker und Pharmaceuten. Herausgegeben von Joh. Rud. Wagner. Six vols. 8vo. Leipzig 1855—1860.

(Continued under the title:)

(*a*) Jahresbericht über die Forschritte und Leistungen der chemischen Technologie und technischen Chemie. Herausgegeben von J. R. Wagner. Nine vols. (vii—xv) 8vo. Leipzig 1861—1869.

(Continued under the title:)

(*b*) Jahresbericht über die Foreschritte und Leistungen der chemischen Technologie und technischen Chemie (from vol. xviii) mit besonderer Berüksichtigung der Gewerbsstatistik. Herausgegeben von J. R. Wagner. Neue Folge. Eleven vols. (xvi—xxvi) 8vo. Leipzig 1870—1880.

(Continued under the title:)

(*c*) Wagner's (R. von) Jahresbericht über die Leistungen der chemischen Technologie, mit besonderer Berücksichtigung der Gewerbestatistik für das Jahr 1880 (1882). Herausgegeben von F. Fischer. Fourteen vols. (xxvii—xl) 8vo. Leipzig 1881—1894.

II. By Purchase.

Buchka, Karl von. Lehrbuch der Analytischen Chemie. Zweite Auflage. Erster Theil. Leipzig und Wein 1902.

III. Pamphlets.

Boehm, Frederick. Olive oil: its sources, production, character and uses. London 1901. From the Author.

Thwaite, B. H. The generation and transmission of electric energy at and from coal pit centres. Pp. 74. London 1901. From the Author.

Thwaite, B. H. The profitable utilisation of power from blast-furnace gases. Pp. 48. London 1901. From the Author.

Roscoe, H. E. Bunsen. A discourse delivered at the Royal Institution, June 1st, 1900. From the Author.

At the next meeting on **Wednesday**, February 19th, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Enzyme action." By A. J. Brown.

"On the velocity of hydrolysis of starch by diastase, with some remarks on enzyme action." By H. T. Brown and T. A. Glendinning.

"Polymerisation products from diazoacetic ester." By O. Silberrad.

"Condensation of phenols with esters of unsaturated acids. Part VII." By S. Ruhemann and H. E. Stapleton.

"The union of hydrogen and oxygen." By H. B. Baker.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 247.

February 19th, 1902. Prof. J. Emerson Reynolds, Sc.D., V.P.R.S., President, in the Chair.

Messrs. E. A. Lewis, R. A. Berry, H. W. Crowther and H. O. Jones were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Bergtheil, Cyril, Checkley, Red Hill, Surrey.
Boardman, Ernest, 41, Knowsley Road, Smithills, Bolton.
Davis, Charles Benson, 218, West 134th Street, New York, U.S.A.
Hopwood, Arthur, 49, Stanley Street, Tunstall.
Roberts, Jonathan Hugh, Oban Gwys, Swansea.
Trimen, Stephen Herbert, 61, St. John's Park, N.
Tunnicliffe, William Wright, Newhall, Burton-on-Trent.
Wain, William Charles, Mercantile Explosive Dept., Sydney, N.S.W.

It was announced that the following changes in the Officers and Council were proposed by the Council :

As Vice-Presidents : Prof. Meldola, F.R.S., and Prof. Frankland, F.R.S., *vice* Mr. Groves, F.R.S., and Prof. Purdie, F.R.S.

As Foreign Secretary ; Prof. W. Ramsay, F.R.S., *vice* Prof. Meldola, F.R.S.

As Ordinary Members of Council : Mr. J. E. Marsh, Dr. J. A. Voelcker, Dr. A. Harden, and Dr. Lewkowitsch, *vice* Mr. Fenton, F.R.S., Mr. Howard, Mr. Pope, and Dr. Crossley.

Mr. A. C. Chapman, Dr. Hewitt, and Dr. Thorne were appointed to audit the Society's accounts.

A Ballot for the Election of Fellows was held and the following were subsequently declared duly elected :

Keith Benham Benham.
Walter Geoffrey Black.
Harry Burrows, Ph.D.
T. K. Buxy, M.A.
Frederick E. Catchpole, B.Sc.
Matthew Bradbury Challen.
Kenneth Macomb Chance, B.A.
William Clifford.
James Ward Daniels.
Frederick Davis, B.Sc.
Evelyn Andros De la Rue, B.A.
William Dennis.
John Kemp Smith Dixon.
Charles Dorée, M.A.
Lewis Eynon.
Alfred Vincent Elsden.
Eugéne Arthur Fasnacht.
Frederick Ferrand.
John Oliver Ferrier.
Clarence J. Green, B.Sc.
Paul Haas, B.Sc., Ph.D.
Noël Heaton, B.Sc.
Eugene Edwin Hennesey, B.A., B.Sc.
George Frederick Holdcroft.
W. Holdsworth Hurtly, D.Sc.
William Brannan Jackson.
David S. Smith Jardin.
Selwyn Philip James Lavelle.
Harry Lucas.
Ernest Bowman Ludlam, B.Sc.
John Ross Mackenzie.
William Maitland, B.Sc.
Francis Martin.
Francis Hylton Molesworth.
Alfred Holley Mundey.
Allan Ogilvie.
Sydney Glyde Stephen Panisset.
William Charles Ross.
Novil Vincent Sidgwick, M.A., D.Sc.
Frank Sturdy Sinnatt.
Robert Eley Blake Smith, B.Sc.
William Southworth.
Francis Bernard Stead, B.A.
James Swain.
Lyon Viccars Turner.
Arthur James Webb, B.A.
Charles Edward Womersley.

Of the following papers, those marked * were read :

*24. "The union of hydrogen and oxygen." By H. B. Baker.

Experiments have been made during the last ten years by H. B. Dixon, Victor Meyer, and by the author, with the object of seeing if the presence of moisture had any influence on the union of hydrogen and oxygen. These experiments have led to negative results. By the use of a new method of preparing very pure hydrogen and oxygen, namely, by the electrolysis of a solution of very pure barium hydroxide, the author has succeeded in preparing these gases so pure and dry that tubes containing them can be heated to redness without union of the gases, whilst tubes containing the undried gases, heated side by side with the dried tubes, readily explode. On the introduction of a small quantity of distilled water into the dried tubes, explosion follows at once. In gases which had been allowed to stand for two days only in contact with distilled phosphorus pentoxide, only a slow combination took place, so slowly that in one case ten minutes' heating in the flame of a Bunsen burner caused the union of only one-third of the partially dried gases. It seems therefore that water is not the only determining factor in the explosion of the heated mixture. In order to see if a still higher temperature would bring about the union, coils of very pure silver wire were heated by an electric current in the dried mixture, when it was found that the silver could be heated to its melting point without causing union.

Experiments have also been made with the object of finding out if the moist gases were measurably dissociated whilst the dry gases were not. By a device of Professor Edward Morley's, used for another purpose, gases were sealed up in tubes in which a contraction of less than 1/7000th of their volume could be detected. The gases were dried before their introduction into the tubes by simply passing them through a phosphorus pentoxide tube. They were then left in contact with the pentoxide for six months. No contraction, even to the small extent above noted, could be observed. The gases tested thus were hydrogen, oxygen, nitrogen, air, and a mixture of hydrogen and oxygen. These tubes were kept in a dark room during the whole period.

It was found that a moist mixture of hydrogen and oxygen united slowly in sunlight, which may perhaps account for some previous failures to get the gases dry enough not to unite. In the first series of experiments above described, the mixed gases were kept in darkness during their contact with the phosphorus pentoxide, lest the action of the drying agent should not be sufficiently rapid to cope with the water being produced by their union.

*25. "Enzyme action." By A. J. Brown.

The author has already shown (*Trans.*, 1892, 61, 380) that in alcoholic fermentation a *constant weight* of sugar is decomposed in unit time by a constant amount of yeast in solutions of equal volume containing different amounts of sugar, and has called attention to the fact that in this respect the action of fermentation differs essentially from that of inversion, which, according to C. O'Sullivan and Tompson (*Trans.*, 1890, 57, 865), follows the law of mass action. At the time the author described his work, the phenomenon of fermentation was believed to be a life function inseparable from the living cell, and therefore it did not appear remarkable that the order of progression of its action should differ from that of inversion; but since Buchner has shown that fermentation, like inversion, is an enzyme action, this point of difference required further investigation as the simple mass action of invertase demonstrated by O'Sullivan and Tompson is often regarded as typical of all forms of enzyme action.

The author has examined the action of invertase on cane sugar, and finds that the velocity of its action differs essentially from that of a mass action, and *resembles that of fermentation.* The velocity of its action represented graphically approximates a *straight line* when not influenced by the accumulation of inversion products. The retarding influence of inversion products occasions the curve found by O'Sullivan and Tompson, and these authors were mistaken in regarding the curve as the logarithmic curve of mass action. In a true mass action the value K, derived from the expression $K=\frac{1}{\theta}\log\frac{1}{1-x}$, for any point of the action is a constant, but this is not the case in inversion changes in which the products of inversion accumulate. On the contrary, for such changes the value $2K$ is nearly constant when derived from the expression, recently suggested by Henri (*Compt. rend.*, 1901, 133, 891), $2K=\frac{1}{\theta}\log\frac{1+x}{1-x}$,—an expression differing essentially from that representing the progress of a mass action.

But although the action of inversion does not follow the law of mass action, it cannot be independent of mass influence, and therefore the effect of mass during inversion change must be restricted by some other influence. This influence the author believes to be due to the existence of time as a factor in the complex changes which probably accompany inversion.

In any simple chemical change the influence of mass regulates the number of molecular *contacts* between acting and reacting molecules in unit time; but if a time factor enters into a molecular reaction there must be a point beyond which the number of molecular *changes* cannot increase owing to the restriction of time in the action, and this point will be determined by the relative frequency of molecular contact and the relative length of the time interval of molecular change. There is good reason to believe that during the inversion of sucrose, this sugar enters into molecular combination with invertase previous to change, which presupposes a complex change and the existence of a time factor of some magnitude. Under these conditions it therefore appears more probable that this factor limits the effect of mass action in inversion changes in solutions of ordinary concentration. But if this is so, there must be a point of dilution in cane sugar solutions when invertase, acting in the dilute solutions, should exhibit an order of change in conformity with simple mass action. The author shows by direct experiment that this point is reached in a solution containing about 1 per cent. of cane sugar, so far confirming the conclusion that a time factor accompanying molecular change limits the action of inversion in all but very dilute solutions of cane sugar.

The action of alcoholic fermentation follows the same order of progression as that of inversion, and the work of Kastle and Loevenhart (*Amer. Chem. Journ.*, 1900, **24**, 491) indicates that the action of lipase progresses in the same manner,—it therefore appears probable that both these enzyme actions are regulated, like inversion, by a time factor. With regard to the actions of such enzymes as diastase, glucase, and peptase there is not at present sufficient evidence on which to base an opinion.

*26. "On the velocity of hydrolysis of starch by diastase with some remarks on enzyme action." By H. T. Brown and T. A. Glendinning.

The rate of change during the hydrolysis of starch by diastase does not conform to the simple logarithmic law of a unimolecular reaction. Throughout the hydrolysis there is a steady augmentation of the coefficient of velocity; in other words, within any given time interval there is more of the residual substance hydrolysed than there should be according to the logarithmic formula.

The results are in the wrong direction to be accounted for by a gradual accumulation of the products of change with a consequent tendency to chemical reversion, nor can they be explained by the intermediate products of change exhibiting a differential resistance to hydrolysis.

If the time curves expressing the rate of hydrolysis of a 3 per cent. solution of soluble starch are critically examined, it is found that up to a hydrolysis of 30 to 40 per cent. the amount of transformation is very nearly a linear function of the time. A further analysis of the curve shows that the remainder is approximately logarithmic.

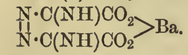
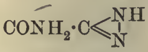
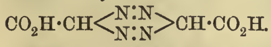
In all essentials, the progress of the hydrolysis of starch coincides with that of the inversion of cane-sugar by invertase, as shown by Adrian Brown in the previous paper. The rate of hydrolysis also conforms closely with the empirical formula of Henri for the inversion of cane sugar.

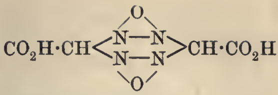
The authors are inclined to adopt a somewhat different explanation of the time curves of hydrolysis from that suggested by Adrian Brown, and one which does not postulate any difference in the time intervals between the successive stages of the reaction other than those due to variations in the respective masses of the reacting substances existing in unit volume.

This hypothesis has been fully elaborated, and an attempt is also made to link the phenomena of enzyme hydrolysis with those of acid hydrolysis, the water ions, or the active dissociated water molecules, being in both cases regarded as the true hydrolysts.

*27. "Polymerisation products from diazoacetic ester."

By O. Silberrad, Ph.D.

In this research, which is a continuation of work already published (Hantzsch and Silberrad, *Ber.*, 1900, 33, 58), the polymers of diazoacetamide are dealt with. The investigation has led to the discovery of a third series of polymeric products from diazoacetic ester, of which the most stable representative appears to be the amide. This compound, which was formerly known as "pseudodiazoacetamide, $C_3HN_4(NH)_2(CONH_2)_3$," is now shown to be imidoazoacetamide, $NH{:}C(CONH_2)\cdot N{:}N\cdot C(CONH_2)NH$. Its constitution has been established chiefly by a comparative study of the action of reagents on this compound and on its isomerides in the other two series of polymeric derivatives of diazoacetamide, namely, the *C-* and *N-dihydrotetrazinedicarboxylamides,* the latter of which has been prepared for the first time. Of the reactions studied, that with alkalis may be taken as characteristic. In the case of the *C-* and *N-*dihydrotetrazinedicarboxylamides saponification occurs in a perfectly normal manner; neither substance shows any inclination to form salts as imidoazoacetamide does. In the presence of mercury, however, *N-*dihydrotetrazinedicarboxylamide forms a compound of such stability that prolonged boiling with concentrated sodium hydroxide entirely fails to saponify the amide. With pseudodiazoacetamide an imido-salt of the amide is first produced, as, for example, the ammonium salt $NH{:}C(CONH_2)N{:}N\cdot C(CONH_2)N(NH_4)$. It was the analysis of these salts which first showed the compound to be a dimolecular polymer of diazoacetamide. Secondary reactions subsequently occur thus (1) Baryta water on warming produces barium imidoazoacetate  $\left.\begin{matrix}\mathrm{N\cdot C(NH)CO_2}\\ \|\\ \mathrm{N\cdot C(NH)CO_2}\end{matrix}\right>\mathrm{Ba}$. (2) The prolonged action of aqueous ammonia at ordinary temperatures gives rise to *iso*diazoacetamide,  $\mathrm{CONH_2\cdot C}\Big<\begin{matrix}\mathrm{NH}\\ |\\ \mathrm{N}\end{matrix}$ together with a small quantity of diazoacetamide. The constitution of the former was deduced chiefly from its action on benzaldehyde, with which it forms benzalazine, $N_2(CHC_6H_5)_2$. (3) Concentrated sodium hydroxide at 100° gives rise to bisdiazoacetic acid,  $\mathrm{CO_2H\cdot CH}\Big<\begin{matrix}\mathrm{N{:}N}\\ \mathrm{N{:}N}\end{matrix}\Big>\mathrm{CH\cdot CO_2H}$.

The action of nitric oxide is also worthy of note as by its means either triazole nitrate, $\mathrm{CH}\Big<\begin{matrix}\mathrm{NH{:}HNO_3}\\ \mathrm{N=\!=\!=N}\end{matrix}\Big>\mathrm{CH}$ (a derivative of *N-*dihydrotetrazine), or bisazoxyacetic acid,  $\mathrm{CO_2H\cdot CH}<\overset{O}{\underset{O}{\begin{matrix}N-N\\N-N\end{matrix}}}>\mathrm{CH\cdot CO_2H}$ (a derivative of *C*-dihydrotetrazine), can be obtained at will.

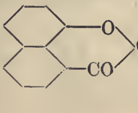
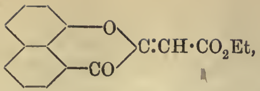
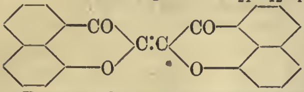
28. "Condensation of phenols with esters of unsaturated acids. Part VII." By S. Ruhemann.

Benzo-1 : 4-pyrone (chromone) and its homologues have basic properties; they dissolve in hydrochloric acid to form hydrochlorides, and these solutions yield platinichlorides; but the salts are unstable and are decomposed by water with re-formation of the benzopyrones.

The author having been unable to obtain hydroxybenzo-1 : 4-pyrones from the dihydric phenols, has attempted to prepare them by starting from their mono-ethers, and from guaiacol and ethyl chlorofumarate has obtained ethyl guaiacoxyfumarate,

$$(\overset{(1)}{C}H_3O)\cdot C_6H_4\cdot\overset{(2)}{O}\cdot C(CO_2Et)\colon CH\cdot CO_2Et,$$

a yellow oil, b. p. 212—213° (at 15 mm.) and the corresponding acid (m. p. 138° with decomposition); on treatment of this acid with strong sulphuric acid a compound was obtained which is most probably methoxybenzo-1 : 4-pyronecarboxylic acid. This the author intends to transform into *O*-hydroxybenzo-1 : 4-pyrone.

It was further shown that the action of ethyl chlorofumarate on α-naphthol differs from the behaviour of the ester towards β-naphthol, for whilst with the latter it yields ethyl β-naphthoxyfumarate, $C_{10}H_7O\cdot C(CO_2Et)\colon CH\cdot CO_2Et$, a yellow, fluorescent oil, b. p. 240—242° (pressure 12 mm.), which on hydrolysis is transformed into the corresponding acid, yellowish plates, m. p. 236° with decomposition, it reacts with α-naphthol to form in addition to a small quantity of ethyl α-naphthoxyfumarate, two substances which belong to a new class of compounds. One has the formula $C_{16}H_{12}O_4$, and crystallises in yellow needles, m. p. 146—147°; the other has the formula $C_{24}H_{12}O_4$, it forms orange needles which do not melt at 335°, are insoluble in the ordinary solvents, but dissolve in boiling nitrobenzene. The first compound is regarded as a derivative of the type  called *naphtharone*, and as having the constitution  ethyl naphtharonylacetate, whilst the compound $C_{24}H_{12}O_4$ is represented by the formula  and termed *bisnaphtharonyl.*

Reasons for assigning these constitutions, and the description of some derivatives of these compounds, were given by the author.

29. "The chemical change produced by the immersion of lead in distilled water." By F. Clowes, D.Sc.

The author finds when very pure lead and ordinary distilled water were employed that much of the lead which underwent change passed into solution most probably as hydroxide, and was removable to a large extent from solution by passage through filter paper, from which it could again be entirely extracted by cold acetic acid. The compound of lead which remained undissolved by the water was found to have the formula $3PbCO_3,PbH_2O_2$.

In order to ascertain the respective parts played by atmospheric oxygen and carbon dioxide in solution, distilled water freed from dissolved gases by boiling was employed. When such water was placed in contact with lead in a vacuum or in an atmosphere of hydrogen, action only took place to the extent of 0·3 part of lead per million of water. When the water employed had been boiled in glass vessels and again exposed to air it never regained its full activity. This inhibitive effect varied with different glass vessels, being most marked in those kinds of glass which gave most dissolved matter to the water; contact of cold water and glass did not produce this effect, which was eliminated, however, in the experiments, the results of which are given below, by boiling the water employed in copper vessels.

The average results, expressed as percentages of lead in terms of the water employed, are shown in the following table:

	24 hours.	48 hours.	72 hours.
Oxygen alone	0·013	0·023	0·029
Carbon dioxide alone	0·005	0·008	0·017
Equal volumes of carbon dioxide and oxygen	0·003	0·003	0·003
Eight volumes of oxygen to one volume of carbon dioxide........................	0·015	0·018	—

This shows clearly that oxygen is the principal and primary agent, and that carbon dioxide exerts a restraining action in proportion to the volume present. It was found that carbon dioxide acted similarly in preventing solution of litharge.

The first action of aërated water apparently consists in oxidation and formation of hydroxide, which is precipitated as hydroxycarbonate by the carbon dioxide. The action is prevented or retarded by the presence of carbon dioxide in the initial stages. Total immersion of the lead also retards the action in presence of air, although the final result is the same whether the lead be wholly or only partially immersed in the water.

Of the substances which prevent this action, sulphuric acid and soluble sulphates are most effective, soluble carbonates are less so, whilst calcium hydroxide is still less so, but when present in larger quantity actually promotes the action.

30. "The bases contained in Scottish shale oil. Part I." By F. C. Garrett and J. A. Smythe.

The authors are continuing the examination of the bases contained in the Broxburn shale oil, of which a short account has been already given (*Proc.*, 1900, **16**, 190) and have completed the investigation of the portion boiling below 164°. The following bases have been isolated and identified:

Pyridine, b. p. 115—116° (in very small quantity).
α-Picoline, b. p. 129·5° (bar. 763 mm.).
αγ-Dimethyl pyridine, b. p. 159—159·5°.
αβ′- ,, ,, b. p. 154—155°.
αα′- ,, ,, b. p. 142·5° (bar. 760 mm.).
αγα′-Trimethyl pyridine, b. p. 170·5° (bar. 760 mm.).

αβ′-Dimethyl pyridine is a colourless liquid with a strong pyridine-like odour; it gives a picrate, m. p. 151—152°; a gold compound, m. p. 156—157°; a platinichloride containing 2 molecules of water and melting (when *anhydrous*) at 238° with decomposition; and a mercurichloride ($C_7H_9,HCl,6HgCl_2$) in very small, heavy crystals, m. p. 163°.

31. "Note on 'liquid nitrogen peroxide as a solvent.'" By P. F. Frankland, F.R.S., and R. C. Farmer, Ph.D.

In the authors' recent communication on "liquid nitrogen peroxide as a solvent" (*Trans.*, 1901, **79**, 1356), they inadvertently omitted to mention the previous work of Bruni and Berti (*Gazz. chim. Ital.*, 1900, **30**, ii, 151), of which they were not cognisant at the time.

It is fortunate that, whilst the two papers deal to some extent with the same subject, the experimental results do not to any great extent overlap, but rather supplement each other.

Bruni and Berti concerned themselves principally with cryoscopic measurements, and thus extended the still earlier work of Ramsay (*Trans.*, 1890, **57**, 590), whereas the authors have investigated the electric conductivity and ebullioscopic behaviour of the solutions of a considerable number of different substances in the liquid peroxide, besides making a somewhat extensive examination of the action of the latter on a number of other substances, organic and inorganic.

The cryoscopic and ebullioscopic determinations agree in showing that the liquid peroxide is in many cases a powerfully associating solvent, and it is noteworthy that Bruni and Berti found acetic acid to be associated to triple molecules at the freezing point of the solvent, whilst the authors' measurements at the boiling point of the latter only revealed an association to double molecules.

The authors desire herewith to express their regret that the important work of these authors had escaped their attention.

ADDITIONS TO THE LIBRARY.

I. By Donation.

Ditte, Alfred. Introduction à l'étude des métaux. Pp. 488. Paris 1902. From the Author.

White, Edmund, and John Humphrey. Pharmacopedia, a commentary on the British Pharmacopœia, 1898. Pp. 696. Ill. London 1901. From the Authors.

II. Pamphlets.

Richards, Theodore William. The relation of the taste of acids to their degree of dissociation. II. (From *The Journal of Physical Chemistry*, vol. iv, No. 3, March, p. 207.) From the Author.

Richards, Theodore William. Suggestion concerning the nomenclature of heat capacity. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvi; No. 18, January, 1901.) From the Author.

Richards, Theodore William. The possible significance of changing atomic volume. (From the *Proceedings of the American Academy o· Arts and Sciences*, vol. xxxvii, No. 1, June, 1901.) From the Author

Richards, Theodore William. The significance of changing atomic volume. II. The probable source of the heat of chemical combination, and a new atomic hypothesis. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvii, No. 15, February, 1902.) From the Author.

Richards, Theodore William. Modification of Hempel's .gas apparatus. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvii, No. 10, November, 1901.) From the Author.

Richards, Theodore William, and Frank Roy Fraprie. The solubility of manganous sulphate. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvi, No. 28, April, 1901.) From the Authors.

Richards, Theodore William, and Ebenezer Henry Archibald. The decomposition of mercurous chloride by dissolved chlorides: a contribution to the study of concentrated solutions. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvii, No. 13, January, 1902.) From the Authors.

Richards, Theodore William, Charles F. McCaffrey, and Harold Bisbee. The occlusion of magnesic oxalate by calcic oxalate, and the solubility of calcic oxalate. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvi, No. 22, April, 1901.) From the Authors.

Richards, Theodore William, and Benjamin Shores Merigold. A new investigation concerning the atomic weight of uranium. (From the *Proceedings of the American Academy of Arts and Sciences*, vol. xxxvii, No. 14, February, 1902.) From the Authors.

At the next meeting, on **Thursday**, March 6th, at 8 p.m., the following papers will be communicated:

"The slow oxidation of methane at low temperatures." By W. A. Bone and R. V. Wheeler.

"Isomeric additive compounds of dibenzyl ketone and deoxybenzoin with benzal-*p*-toluidine, *m*-nitrobenzalaniline and benzal-*m*-nitraniline. Part III." By F. E. Francis.

"Mesoxalic semi-aldehyde." By H. J. H. Fenton and J. H. Ryffel.

"*m*-Nitrobenzoylcamphor." By M. O. Forster and Miss F. M. G. Micklethwait.

"Picrimidothiocarbonic esters." By J. C. Crocker.

"The identity of osyritin and myrticolorin." By A. G. Perkin.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 248.

March 6th, 1902. Dr. Divers, F.R.S., Vice-President, in the Chair.

Messrs. W. G. Black, L. V. Turner, and H. Lucas were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Ashe, James Samuel, The Adelaide Hospital, Dublin.
Cook, Arthur James, 167, Richmond Road, Hackney, N.E.
Dobson, Henry Arthur, Paisley Street, Orange, N.S.W.
Kewley, James, King's College, Cambridge.
Macknight, Alexander, Brucefield, Whitburn, N.B.
Martindale, William Harrison, 10, New Cavendish Street, W.
Peck, John Wicliffe, 28, West Ella Road, Harlesden, N.W.

The list of names of those recommended for election as Officers and Members of Council was read.

Of the following papers, those marked * were read :—

*32. "The slow oxidation of methane at low temperatures." By W. A. Bone and R. V. Wheeler.

The authors have studied the slow oxidation of methane at temperatures between 300° and 400° in a supply of oxygen just sufficient to burn the carbon to carbon monoxide. The method adopted consisted in sealing mixtures of two volumes of methane and one volume of oxygen in bulbs of boro-silicate glass, which were maintained at constant temperatures of 300°, 325°, 350°, and 400° for periods of time varying from 1 day to 3 weeks. The bulbs were afterwards examined and a careful analysis of the resulting mixture made.

The results indicate (1) that the disappearance of the oxygen is accompanied by a proportionate diminution in the volume of the cooled products, due to formation of water. (2) That at no stage of the process is either free hydrogen or free carbon liberated. (3) That a portion only of the methane is burnt, the carbon of which appears as carbon monoxide or dioxide, and the whole of the hydrogen as water. (4) That no other products can be detected at any stage of the oxidation.

Since the interaction of methane and oxygen at these temperatures is a 'surface' phenomenon, it is impossible to measure the relative velocities of the reaction at different temperatures, but evidence was obtained that the velocity increases with rising temperature. Thus at 300°, where the velocity is just appreciable, the disappearance of oxygen and formation of water can only be detected after the lapse of one or two weeks. At 400°, on the other hand, the whole of the oxygen always disappeared within a single day, and at 350°, in some instances, in three days.

Experiments have shown that similar bulbs containing electrolytic gas can be maintained at 350° for a week and at 400° for three days, without any visible formation of water occurring; at 400°, in one instance out of three, a marked formation of water took place in a week; in the other two bulbs, however, no change could be detected.

A study of the following possible secondary reactions at 325°, 350°, and 400°, namely (1) $CO + H_2O \rightleftharpoons CO_2 + H_2$, and (2) $\underset{\text{(moist)}}{2CO + O_2 = 2CO_2}$, indicates that no complication arising from them enters into the methane-oxygen experiments. Further, it has been proved that the following substances do not react at 350—400°, namely (1) methane and steam, (2) methane and carbon dioxide, (3) carbon and steam.

The authors therefore conclude that the first stage of the oxidation of methane at these temperatures does not consist of a '*selective combustion*' of either hydrogen or carbon, but in a *simultaneous oxidation of carbon and hydrogen*, as represented by the equation $2CH_4 + 3O_2 = 2CO + 4H_2O$.

The occurrence of carbon dioxide in the products (and in many cases as much as one-third to one-half of the carbon burnt appears as the dioxide) cannot be explained on the supposition that carbon monoxide liberated in the primary oxidation is subsequently *gradually* oxidised through the agency of steam and oxygen, or steam alone. The more probable explanation is that the carbon monoxide and steam molecules which simultaneously come into being in the primary oxidation are, *at the moment of formation*, in a very labile and reactive condition, and this would favour the rapid exchange of oxygen in the system,

$\left.\begin{array}{c|c} \mathrm{CO} & \mathrm{OH_2} \\ \mathrm{CO} & \mathrm{OH_2} \end{array}\right| \mathrm{O_2}$. The carbon dioxide is mainly, if not entirely, produced during this short 'labile period.'

*33. "Isomeric additive compounds of dibenzylketone and deoxybenzoin with benzal-*p*-toluidine, *m*-nitrobenzalaniline, and benzal-*m*-nitraniline. Part III." By F. E. Francis, B.Sc., Ph.D.

The additive compounds formed with dibenzylketone and deoxybenzoin with benzal-*p*-toluidine were unstable and consequently unsatisfactory for confirming the existence of the so-called α-, β-, and γ-modifications. In the case of dibenzylketone and *m*-nitrobenzalaniline the β-modification obtained by recrystallisation of the α-form from benzene containing traces of piperidine melted 31° higher, and with dibenzylketone and benzal-*m*-nitraniline 43° higher than the α-additive product; in the latter case, there was also a distinct change in the solubility and appearance of the β-form. These were considered satisfactory confirmations of the individuality of the β-modification, because in cases previously investigated the rise in melting point was never greater than 10—12°, and since the β-modifications were transformed into the α- by means of heat, this small difference in melting point was not very satisfactory. α-Dibenzylketone benzal-*m*-nitraniline on recrystallisation from benzene containing traces of sodium ethoxide appears to be converted into the γ-modification, and the melting point rises from 134° to 182·3°, but this was the only case observed. Substances of much higher melting point and smaller solubility, and apparently belonging to neither α-, β-, or γ-modifications, were obtained in the case of deoxybenzoin and benzal-*p*-toluidine, deoxybenzoin and benzal-*m*-nitraniline, and dibenzylketone and *m*-nitrobenzalaniline. These are similar in molecular weight and composition to the isomerides of lower melting point, and it is interesting to note that whereas dibenzylketone and benzal-*m*-nitraniline give a pure α-additive compound, deoxybenzoin with the same substance only gives the isomeride of higher melting point.

Discussion.

Dr. Lowry asked if it was not possible that one of the three modifications described by the author as the α-, β- and γ-forms might be a stable mixture of two isomerides and not a single chemical compound. In the case of the three modifications of π-bromonitrocamphor, those melting at 108° and 142° were found to be the normal and pseudo-nitro-compounds respectively, whilst that melting at 126° was only a stable mixture of these two.

Dr. Francis, in reply, said that he had been unable to obtain any evidence that any of the modifications described was a mixture, and that if they were mixed they could be again separated by fractional crystallisation.

*34. "Mesoxalic semi-aldehyde." By H. J. H. Fenton, F.R.S., and J. H. Ryffel, B.A., B.Sc.

Chlorine is slowly absorbed by a solution of tartaric acid containing iron in the ferrous state, and the product, after removal of the unaltered tartaric acid, is found to have powerful reducing and other aldehyde properties. With phenylhydrazine, it yields a bright orange precipitate having the composition $C_{15}H_{14}N_4O_2$, which is identical in every respect with the osazone obtained by Nastvogel from dibromopyruvic acid (*Annalen*, 1888, **248**, 85) and by Will from collodion-wool (*Ber.*, 1891, **24**, 400 and 3831).

A re-investigation, however, proves that the true melting point of this osazone is 222—224° instead of the lower number, 201—207°, ascribed to it by various authors. This osazone has the constitution $CH{:}N_2HPh{\cdot}C{:}N_2HPh{\cdot}CO_2H$ and corresponds either to hydroxypyruvic acid, tartronic semi-aldehyde, or mesoxalic semi-aldehyde.

With hydroxylamine, however, the *dioxime*, $CHNOH{\cdot}CNOH{\cdot}CO_2H$, or dioximidopropionic acid is obtained identical with that prepared by Söderbaum from dibromopyruvic acid (*Ber.*, 1892, **25**, 904) and by oxidation with cupric hydroxide in alkaline solution *mesoxalic acid* results.

Since the oxidation product is free from chlorine, these facts leave no room for doubt as to the nature of the substance in question, namely, that it is the semi-aldehyde of mesoxalic acid.

Its formation from tartaric acid in the manner above described is due to the initial production of dihydroxymaleic acid, and it may be prepared in a pure state directly from the latter acid by the action of ferric salts. With ferric sulphate or chloride, for example, the change takes place almost quantitatively according to the equation : $C_4H_4O_6 + Fe_2(SO_4)_3 = C_3H_2O_4 + 2FeSO_4 + H_2SO_4 + CO_2$.

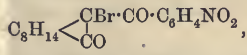
After removal of the iron salt and free mineral acid, the product is obtained as a thick syrup, which, so far, has not been induced to crystallise. The derivatives and transformations of this aldehyde-acid are being further investigated.

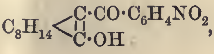
*35. "The action of hydrogen peroxide on carbohydrates in the presence of ferrous salts. III." By R. S. Morrell and J. M. Crofts.

The specific action of hydrogen peroxide in the presence of ferrous sulphate was first demonstrated by Fenton in the oxidation of tartaric acid to dihydroxymaleic acid (*Trans.*, 1894, **65**, 899). Glucose, lævulose, arabinose, and rhamnose have been shown by the authors to be transformed by this peculiar reaction into osones, which were recognised by their power to react with substituted hydrazines at the ordinary temperature (*Trans.*, 1899, **75**, 786, and 1900, **77**, 1219) It has been found that mannose on oxidation gave an osone which yielded with phenylhydrazine at the ordinary temperature phenylglucosazone. The preparation of pure glucosone from both glucose and lævulose has been attempted, and a white, amorphous solid has been obtained which gave analytical results agreeing with the formulæ $C_6H_{12}O_6$ and $C_6H_{10}O_6$. This substance reacted readily with phenylhydrazine at the ordinary temperature and furnished a good yield of phenylglucosazone. The glucosone from glucose was feebly dextrorotatory, whilst that from lævulose was slightly lævorotatory. Glucosone obtained by E. Fischer (*Ber.*, 1889, **22**, 87) is lævorotatory.

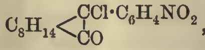
An aqueous solution of glucosone prepared from either glucose or lævulose on oxidation with bromine at 40° furnished a good yield of the calcium salt of a trioxybutyric acid. The barium salt of the same acid has been obtained, and both the calcium and barium salts seem to be identical with *d*-erythronic acid (Ruff, *Ber.*, 1899, **32**, 3678). The calcium and barium salts of this acid obtained from glucosone prepared from either dextrose or lævulose have yielded butyric acid on reduction with hydriodic acid and phosphorus.

*36. "*m*-Nitrobenzoylcamphor." By M. O. Forster and Miss F. M. G. Micklethwait.

α′-m-*Nitrobenzoyl-α-bromocamphor*,  $C_8H_{14}<\begin{array}{l}CBr\cdot CO\cdot C_6H_4NO_2\\ |\\ CO\end{array}$, prepared from α′-benzoyl-α-bromocamphor and fuming nitric acid, separates from methyl alcohol in pale yellow, flat, prismatic needles melting at 93—94°; a 2 per cent. solution in chloroform has $[\alpha]_D = +87\cdot9°$. α-m-*Nitrobenzoyl-α′-bromocamphor*, obtained in a similar manner from the isomeric benzoylbromocamphor, crystallises in aggregates of small, pale yellow needles and melts at 101—102°; a 2 per cent. solution in chloroform has $[\alpha]_D = -26\cdot1°$.

Enolic m-*nitrobenzoylcamphor*,  $C_8H_{14}<\begin{array}{l}C\cdot CO\cdot C_6H_4NO_2\\ \|\\ C\cdot OH\end{array}$, formed on reducing the nitrobenzoylbromocamphors with alcoholic potash, crystallises from alcohol in long, pink, silky needles melting at 106—107°; it has not been obtained in the ketonic form, but the specific rotation of a 2 per cent. solution in chloroform, having $[\alpha]_D = +209{\cdot}5°$ when freshly prepared, falls to $+200{\cdot}1°$ in the course of several days, indicating slight transformation into the isomeride. *m*-Nitrobenzoylcamphor dissolves in aqueous alkali hydroxides and the alcoholic solution develops an intense purple coloration with ferric chloride; oxidation with potassium permanganate gives rise to camphoric and *m*-nitrobenzoic acids. The *acetyl* derivative crystallises from light petroleum in pale brown needles and melts at 127—128°.

Enolic o-*nitrobenzoylcamphor* crystallises from alcohol in pale brown, transparent prisms and melts at 118°; a 2 per cent. solution in chloroform has $[\alpha]_D = +44{\cdot}5°$ when freshly prepared, and $+60{\cdot}5°$ after an interval of several days.

α′-m-*Nitrobenzoyl-α-chlorocamphor*,  $\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{CCl\cdot C_6H_4NO_2}\\ \mid\\ \mathrm{CO}\end{array}$, crystallises from alcohol in aggregates of pale yellow prisms and melts at 72—74°; a 2 per cent. solution in chloroform has $[\alpha]_D = +40{\cdot}4°$.

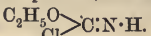
α-m-*Nitrobenzoyl-α′-chlorocamphor* separates from alcohol in small, nearly colourless needles and melts at 110°; a 2 per cent. solution in chloroform has $[\alpha]_D = +7{\cdot}1°$. When these isomerides are heated with alcoholic potash, enolic *m*-nitrobenzoylcamphor is not formed; the sole products are α-chlorocamphor and *m*-nitrobenzoic acid.

*37. "The Cloëz reaction." By F. D. Chattaway and J. M. Wadmore.

The reaction between cyanogen chloride or bromide and an alcoholic solution of sodium ethylate appears at first sight to be inconsistent with the nitrogen halogen constitution which we have shown cyanogen chloride and bromide to possess. It becomes intelligible, however, when we consider the behaviour of the nitrogen halogen linkage towards alcohol.

Halogen attached to nitrogen reacts very readily with alcohol, the halogen being invariably replaced by hydrogen and a hypohalogen ester formed thus: $:\!N - X + C_2H_5OH = :\!N\cdot H + C_2H_5OX$.

The interaction of ethyl alcohol and trichloriminocyanuric acid, when ethyl hypochlorite and cyanuric acid are produced, is a simple case. In the Cloëz reaction, cyanogen chloride or bromide first reacts with the alcohol as a typical nitrogen halogen compound, forming hydrocyanic acid and ethyl hypochlorite or hypobromite, thus: $C\!:\!N\cdot Cl + C_2H_5OH = C\!:\!N\cdot H + C_2H_5OCl$.

These then combine and form ethyl iminochlorocarbonate, the hydrocyanic acid, or sodium cyanide, since sodium ethylate is present, behaving as an unsaturated substance: $C_2H_5OCl + C\colon N\cdot H =$  $\left.\begin{matrix}C_2H_5O\\ Cl\end{matrix}\right> C\colon N\cdot H$.

The ethyl iminochlorocarbonate then reacts in various ways to form the different substances which have been isolated from the product of the action, for example, it reacts with alcohol to form diethyl iminocarbonate, with water to form urethane, whilst three molecules interact with elimination of hydrogen chloride to produce normal triethyl cyanurate.

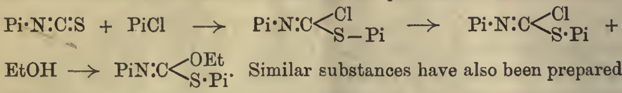
DISCUSSION.

Professor **TILDEN** thought Dr. Chattaway had brought forward a body of evidence which practically established his case, but he would like to inquire whether the production of a nitrile, by interaction between a common cyanide and a haloid compound, had engaged the attention of the authors, and what explanation they would give of the mechanism of the change. In such interactions, carbon appears to be directly attached to carbon, and there is no evidence of even a temporary formation of a compound in which the cyanide group is linked on by means of the nitrogen.

Dr. **CHATTAWAY**, in reply, stated that the imino-structure of cyanides admitted of action occurring in three ways, addition to the nitrogen, or to both nitrogen and carbon, or to carbon, taking place thus: $H\cdot N\colon C + X_2 = HX_2\vdots N\colon C$; or $H\cdot N\colon C + X_2 = H\cdot NX\cdot CX$; or $H\cdot N\colon C + X_2 = H\cdot N\colon C\colon X_2$, the mode of interaction in any particular case and the further secondary changes being determined by the nature of the cyanogen derivative and by that of the substance interacting with it. All reactions of these compounds could be formulated according to one or other of these types. The imino-formulæ of the cyanides are capable of expressing conventionally three phases of atomic relationship, the atoms composing a single molecule can only be in one phase at any instant, but the particular phase at which it reacts is determined by a related phase of the interacting molecule.

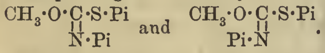
38. "The picrimidothiocarbonic esters." By J. C. Crocker, B.A.

When picryl chloride is treated with ammonium thiocyanate in alcoholic solution, a reaction readily takes place from which a well crystallised yellow substance is obtained, having the empirical formula $C_{15}H_9N_7SO_{13}$. On hydrolysis, it yields picramide. The reaction may be thus explained. Picryl thiocarbimide, $Pi\cdot N\colon C\colon S$, is probably the first product. A molecule of this substance adds on another molecule of picryl chloride, the chlorine atom becoming attached to the carbon atom and the picryl group to the sulphur atom. The acid chloride thus formed reacts with the alcohol to form a picrimidopicrylthiocarbonic ester with the elimination of hydrochloric acid. Thus:



$$\mathrm{Pi{\cdot}N{:}C{:}S + PiCl \longrightarrow Pi{\cdot}N{:}C{<}^{Cl}_{S-Pi} \longrightarrow Pi{\cdot}N{:}C{<}^{Cl}_{S{\cdot}Pi} + EtOH \longrightarrow PiN{:}C{<}^{OEt}_{S{\cdot}Pi}}.$$

Similar substances have also been prepared from methyl, propyl, and *iso*butyl alcohols. In the case of methyl alcohol, two substances have been obtained, which are stereoisomeric, corresponding to the "syn-" and "anti-" forms of the oximes



$$\begin{array}{l}\mathrm{CH_3{\cdot}O{\cdot}C{\cdot}S{\cdot}Pi}\\ \qquad\ \ \|\\ \qquad\ \mathrm{N{\cdot}Pi}\end{array} \text{ and } \begin{array}{l}\mathrm{CH_3{\cdot}O{\cdot}C{\cdot}S{\cdot}Pi}\\ \qquad\ \ \|\\ \quad\ \mathrm{Pi{\cdot}N}\end{array}.$$

39. "Robinin, violaquercetin, myrticolorin and osyritrin."
By A. G. Perkin.

In continuation of the research of which a preliminary account has already been given (*Proc.*, 1901, **17**, 87), the author has re-examined the properties of myrticolorin, $C_{27}H_{28}O_{16}$, a quercetin glucoside present in *Eucalyptus macrorhyncha,* which, as described by H. G. Smith (*Trans.*, 1898, **73**, 697), differed mainly from osyritrin (*Proc.*, 1901, **17**, 87) in that the sugar derived from it appeared to be galactose. As Smith (private communication) finds on re-examination that this is dextrose, comparative experiments have been carried out. The results show that myrticolorin is identical with osyritrin.

40. "The nitration of *s*-trihalogen anilines." By K. J. P. Orton.

The carefully regulated action of nitric acid on the six *s*-trihalogen anilines, *s*-tribromoaniline, 2-chloro-4 : 6-dibromoaniline, 2 : 6-dichloro-4-bromoaniline, 4-chloro-2 : 6-dibromoaniline, 2:4-dichloro-6-bromoaniline, and *s*-trichloroaniline has been investigated. The anilines were dissolved (or suspended) in glacial acetic acid; to the solution nitric acid free from nitrous acid was added; the mixture, which now contained crystalline aniline nitrate, was heated on the water-bath. From their behaviour when this mixture is heated, the anilines may be sharply divided into two classes, namely, those with a bromine atom in the para-position relative to the amino-group and those with a chlorine atom in the para-position. With the first, the nitrate of the aniline dissolves quickly, forming an orange solution, which becomes gradually more yellow in colour and gives off bromine; on cooling, an aniline crystallises out, in which the *p*-bromine atom has been replaced by a nitro-group; thus, from *s*-tribromoaniline, 2 : 6-dibromo-4-nitroaniline is obtained (compare Losanitsch, *Ber.*, 1882, **15**, 474); from 2-chloro-4 : 6-dibromoaniline, 2-chloro-6-bromo-4-nitroaniline (m. p. 177°), and from 2 : 6-dichloro-4-bromoaniline, 2 : 6-dichloro-4-nitroaniline are obtained. Secondly, when a chlorine atom is in the para-position, a solution is obtained, transiently of a purple colour, which quickly passes to magenta and then slowly to a deep crimson. No chlorine or bromine is evolved, nor are anilines detectable in which a bromine atom in an ortho-position or the chlorine atom in the para-position has been replaced by the nitro-group.

During the period of heating there can be isolated from the solutions of both the above classes of anilines a small quantity of the corresponding nitroamines; thus, from *s*-tribromoaniline is obtained *nitroamino*-2 : 4 : 6-*tribromobenzene,* slender flesh-coloured needles (from water) melting and decomposing at 143—144°; and from *s*-trichloroaniline, *nitroamino*-2 : 4 : 6-*trichlorobenzene,* slender flesh-coloured needles (from water) melting and decomposing at 135°. In solution in acetic acid, in the presence of a trace of a mineral acid, the nitroamines themselves undergo change, that from *s*-tribromoaniline yielding 2 : 6-dibromo-4-nitroaniline, whereas that from *s*-trichloroaniline yields a characteristic crimson solution. From the crimson solution can be isolated a small quantity of a *red* crystalline substance, melting and decomposing at 143°. Experiments on the preparation of this and allied substances are now in progress.

41. "Some *s*-nitrochlorobromoanilines and their derivatives."

By K. J. P. Orton.

The following anilines, acetanilides, diacetanilides, and chloroamino-derivatives have been prepared in connection with the investigation described in the preceding communication.

2-*Chloro*-6-*bromo*-4-*nitroaniline,* $C_6H_2ClBr(NO_2)\cdot NH_2$, prepared by chlorinating 2-bromo-4-nitroaniline, long, yellow, prismatic needles melting at 177°; 2-*chloro*-6-*bromo*-4-*nitroacetanilide,* $C_6H_2ClBr(NO_2)\cdot NHAc$, slender, colourless prisms melting at 221—222°; 2-*chloro*-6-*bromo*-4-*nitrodiacetanilide,* $C_6H_2ClBr(NO_2)\cdot NAc_2$, colourless four-sided prisms melting at 134°; *acetylchloroamino*-2-*chloro*-6-*bromo*-4-*nitrobenzene,* $C_6H_2ClBr(NO_2)\cdot NClAc$, white, lustrous prisms melting at 84—85°. 2-*Chloro*-4-*bromo*-6-*nitroaniline,* $C_6H_2ClBr(NO_2)\cdot NH_2$, silky, yellow needles melting at 114°; 2-*chloro*-4-*bromo*-6-*nitroacetanilide,* $C_6H_2ClBr(NO_2)\cdot NHAc$, prepared by nitrating 2-chloro-4-bromoacetanilide, white needles or prisms melting at 194°; *acetylchloroamino*-2-*chloro*-4-*bromo*-6-*nitrobenzene,* $C_6H_2ClBr(NO_2)\cdot NClAc$, long, pale yellow, lustrous, very soluble prisms melting at 56—57°. 4-*Chloro*-2-*bromo*-

6-*nitroaniline*, $C_6H_2ClBr(NO_2)\cdot NH_2$, silky, yellow needles melting at 114—115°; 4-*chloro-2-bromo-6-nitroacetanilide*, $C_6H_2ClBr(NO_2)\cdot NHAc$, prepared by nitrating 4-chloro-2-bromoacetanilide, white prisms melting at 207°. *Acetylchloroamino*-2 : 6-*dibromo*-4-*nitrobenzene*, $C_6H_2Br_2(NO_2)\cdot NClAc$, small, lustrous, four-sided prisms, with domed ends, melting at 110—111°. 2 : 4-*Dibromo*-6-*nitrodiacetanilide*, $C_6H_2Br_2(NO_2)\cdot NAc_2$, prepared by boiling the aniline with excess of acetic anhydride, aggregates of prisms or rhombs melting at 96—97°. 2 : 3 : 4 : 6-*Tetrabromoacetanilide*, $C_6HBr_4\cdot NHAc$, prepared from tetrabromoaniline, silky, white needles melting at 228—229°; 2 : 3 : 4 : 6-*tetrabromodiacetanilide*, $C_6HBr_4\cdot NAc_2$, lustrous, four-sided prisms with domed ends, melting at 164°. 2 : 3 : 6-*Tribromo*-4-*nitroaniline*, $C_6HBr_3(NO_2)\cdot NH_2$, prepared by brominating 3-bromo-4-nitroaniline, pale lemon-yellow needles melting at 155—155·5°. 2 : 3 : 4-*Tribromo*-6-*nitroaniline*, $C_6HBr_3(NO_2)\cdot NH_2$, prepared from 3-bromo-6-nitroaniline, orange-yellow needles melting at 165·5—166°; 2 : 3 : 4-*tribromo*-6-*nitroacetanilide*, $C_6HBr_3(NO_2)\cdot NHAc$, colourless, flattened needles melting at 221°.

42. "The resolution of pheno-α-aminoheptamethylene into its optical isomerides. Tartrates of pheno-α-aminoheptamethylene and of hydrindamine." By F. S. Kipping and A. E. Hunter.

An investigation of the salts produced by the combination of *dl*-pheno-α-aminoheptamethylene with tartaric acid has shown that this base behaves quite differently from *dl*-hydrindamine (pheno-α-aminopentamethylene) in spite of the similarity in constitution of the two bases.

dl-*Pheno-α-aminoheptamethylene*-d-*tartrate*, $2C_{11}H_{15}N,C_4H_6O_6 + \frac{1}{2}H_2O$, separates from neutral and from acid solutions of the *dl*-base in aqueous tartaric acid, in lustrous prisms decomposing at about 235°; in aqueous solution $[\alpha]_D = +13°$.

l-*Pheno-α-aminoheptamethylene hydrogen* d-*tartrate*, $C_{11}H_{15}N,C_4H_6O_6 + 3H_2O$, is obtained when the solution of the normal tartrate is mixed with excess of tartaric acid and fractionally crystallised; it forms slender prisms and melts at 181—182°; its aqueous solutions are feebly lævorotatory ($[\alpha]_D = -1·6°$ approximately).

l-*Pheno-α-aminoheptamethylene* d-*tartrate*, $2C_{11}H_{15}N,C_4H_6O_6$, prepared from the *l*-base, crystallises in transparent, triangular plates and decomposes at 215—217°. The *hydrochloride* of the *l*-base forms lustrous prisms, and in dilute aqueous solution its specific rotation is $[\alpha]_D = +24°$.

Benzoyl-l-*pheno-α-aminoheptamethylene*, $C_{11}H_{14}N\cdot COPh$, crystallises in needles, melts at 175—176°, and is dextrorotatory in methyl alcoholic solution.

d-*Pheno-a-aminoheptamethylene* d-*tartrate*, $2C_{11}H_{15}N,C_4H_6O_6$, can be isolated from the mother liquors obtained after separating the hydrogen salt of the *l*-base; it is anhydrous and decomposes at about 216—217°.

d-*Pheno-a-aminoheptamethylene hydrogen tartrate*, $C_{11}H_{15}N,C_4H_6O_6$, prepared by treating the normal salt with tartaric acid, decomposes at about 205—206°.

dl-*Hydrindamine hydrogen* d-*tartrate*, $C_9H_{11}N,C_4H_6O_6+H_2O$, crystallises in slender needles, melts at 168—169°, and is not resolved or changed in any way by repeated crystallisation from water. The normal d-*tartrate* of the *dl*-base forms plates melting at about 200° and dissociates hydrolytically in aqueous solution.

l-*Pheno-a-aminoheptamethylene* d-*bromocamphorsulphonate*,

$$C_{11}H_{15}N,C_{10}H_{14}BrO\cdot SO_3H,$$

crystallises in prisms melting at 216—217°; in dilute aqueous solution $[\alpha]_D = +47\cdot8°$.

ADDITIONS TO THE LIBRARY.

I. By Donation.

Landauer, John. Blowpipe analysis. Pp. 173. London 1901. From the Publishers.

Remsen, Ira. A college text-book of chemistry. Pp. 689. London 1901. From the Publishers.

Söderbaum, Henrik Gustav. Jac. Berzelius. Sjalfbiografiska anteckeningar. Utgifna af Kongl. Svenska Vetenskapsakademien genom H. G. S. Pp. 246. Stockholm 1901. From C. P. Sandberg.

Travers, Morris William. The experimental study of gases. An account of the experimental methods involved in the determination of the properties of gases, and of the more important researches connected with the subject. Pp. 323. London 1901. From the Publishers.

II. Purchase.

Elbs, Karl. Übungsbeispiele für die elektrolytische Darstellung chemischer Präparate. Zum Gebrauch in Laboratorium für Chemiker und Elektrochemiker. Pp. 100. Ill. Halle-a-S. 1902.

Encomium Argenti Vivi. A treatise upon the use and properties of quicksilver, or, the natural, chemical, and physical history of that surprising mineral, extracted from the writings of the best naturalists, chemists, and physicians. Wherein its various operations are accounted for, and the use of it recommended: with some remarks upon the animadversions of Dr. Turner upon belloste. London.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society, for the election of Officers and Council, and for other business, will be held on **Wednesday**, March 26th, at **half-past four** o'clock in the afternoon.

RAOULT MEMORIAL LECTURE.

The Raoult Memorial Lecture will be delivered by Professor van't Hoff, on **Wednesday**, March 26th, at **9** p.m.

This Lecture will be delivered, by kind permission of the Managers, in the Theatre of the Royal Institution, Albemarle Street, W.

Admission will be by ticket only. Each Fellow of the Society will be entitled to two tickets, which may be obtained on application to the Assistant Secretary, Chemical Society, Burlington House.

At the next meeting, on **Wednesday**, March 19th, at **5.30** p.m., the following papers will be communicated:

"The absorption spectra of metallic nitrates. Part I." By W. N. Hartley.

"A method of determining the ratio of distribution of a base between two acids." By H. M. Dawson and F. E. Grant.

"On the molecular complexity of acetic acid in chloroform solution." By H. M. Dawson.

"On the existence of polyiodides in nitrobenzene solution." By H. M. Dawson and R. Gawler.

"Nitrogen chlorides containing the propionyl groups." By F. D. Chattaway.

"Derivatives of *a*-aminocamphoroxime." By A. Lapworth and A. W. Harvey.

"Preparation of sulphamide from ammonium amidosulphite." By E. Divers and M. Ogawa.

"Hypoiodous acid." By R. L. Taylor.

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Issued 26/3/02

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 249.

Wednesday, March 19th, 1902. Professor Emerson Reynolds, Sc.D., V.P.R.S., President, in the Chair.

Messrs. Catchpole, Green, and Hanson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Clowes, George H. A., Gratwick Research Laboratory, Buffalo, U.S.A.
Crookes, Henry, 109, Ladbroke Grove, W.
Everitt, Walter, 83, The Grove, Ealing, W.
Gill, J. Arthur, 19, Burma Road, Stoke Newington, N.
Griffiths, John T., Grammar School, Hanley Castle, Worcestershire.
King, Sidney Isaac, 49, Arundel Square, N.
Mathieson, Robert, Rillbank, Innerleithen, Peebleshire.
Mence, George Augustus Henry, Ouse Villa, St. Ives, Hunts.
Taylor, Thomas, 12, Ancaster Drive, Great Western Road, W.
Wood, Frank Stanley, 25, Suffolk Street, Newland, Hull.

The Secretary announced that the Treasurer, Professor Tilden, had represented the Society at the recent celebration of the Jubilee of The Owens College, Manchester, and had presented the following congratulatory Address from the Society:

"The President, Council, and Fellows of the Chemical Society desire on this the present occasion of the celebration of the Fiftieth Anniversary of the foundation of Owens College to express their high appreciation of the conspicuous services rendered to the cause of scientific education by the foundation and ever increasing activity of the College.

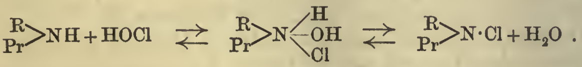
"They recall with especial satisfaction the contributions to Chemical Science which have emanated from the laboratories of Owens College under the direction of the successive eminent Professors of Chemistry, who must be regarded as the immediate scientific successors of John Dalton, the founder of Modern Chemistry. With sincere wishes for the future development and extended usefulness of the College they desire to tender to the President, Council, Fellows and Students an expression of hearty congratulation on the celebration of this their Jubilee.

J. EMERSON REYNOLDS, *President.*
WILLIAM A. TILDEN, *Treasurer.*
WYNDHAM R. DUNSTAN,
ALEXANDER SCOTT, } *Secretaries.*"
RAPHAEL MELDOLA,

Of the following papers those marked * were read:—

*43. "Nitrogen chlorides containing the propionyl group." By F. D. Chattaway.

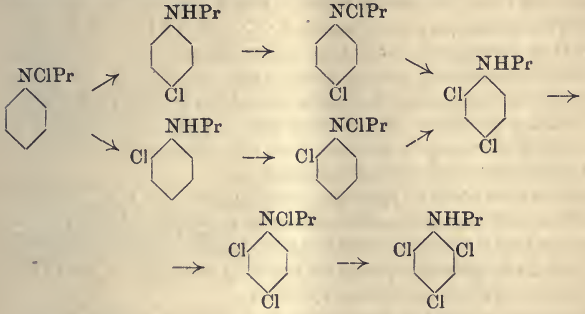
Aniline and the chloro-substituted anilines readily yield propionyl derivatives, which, on treatment with excess of hypochlorous acid, are converted into substituted nitrogen chlorides. In these reactions, hypochlorites are probably first formed, the nitrogen developing its higher valency, water being subsequently eliminated. The reaction is a reversible one:



$$\begin{matrix}R\\Pr\end{matrix}\!>NH+HOCl \rightleftarrows \begin{matrix}R\\Pr\end{matrix}\!>N\begin{matrix}\diagup H\\-OH\\\diagdown Cl\end{matrix} \rightleftarrows \begin{matrix}R\\Pr\end{matrix}\!>N{\cdot}Cl+H_2O\ .$$

These nitrogen chlorides show all the characteristic reactions of the group, the chief feature of such reactions being the invariable replacement of the halogen by hydrogen.

When there is hydrogen, either in the para- or the ortho-position, transformation of the nitrogen chloride into the isomeric substituted anilide readily takes place according to the scheme:



The following compounds have been prepared:—*Chloroiminopropionanilide*, $C_6H_5\cdot NCl\cdot COC_2H_5$, colourless plates, m. p. 77°; p-*chloropropionanilide*, $C_6H_4Cl\cdot NH\cdot COC_2H_5$, plates, m. p. 141°; *chlorimino*-p-*chloropropionanilide*, $C_6H_4Cl\cdot NCl\cdot COC_2H_5$, colourless plates, m. p. 55°, *bromoimino*-p-*chloropropionanilide*, $C_6H_4Cl\cdot NBr\cdot COC_2H_5$, yellow prisms, m. p. 71°; o-*chloropropionanilide*, $C_6H_4Cl\cdot NH\cdot COC_2H_5$, colourless plates, m. p. 91°; *chloroimino*-o-*chloropropionanilide*, $C_6H_4Cl\cdot NCl\cdot COC_2H_5$, colourless plates, m. p. 57°; *bromoimino*-o-*chloropropionanilide*, $C_6H_4Cl\cdot NBr\cdot COC_2H_5$, pale yellow prisms, m. p. 106°; 2 : 4-*dichloropropionanilide*, $C_6H_3Cl_2\cdot NH\cdot COC_2H_5$, colourless prisms, m. p. 121°; *chloroimino*-2 : 4-*dichloropropionanilide*, $C_6H_3Cl_2\cdot NCl\cdot COC_2H_5$, colourless plates, m. p. 64°; *bromoimino*-2 : 4-*dichloropropionanilide*, $C_6H_3Cl_2\cdot NBr\cdot COC_2H_5$, pale yellow rhombs, m. p. 66°; 2 : 4-*trichloropropionanilide*, $C_6H_2Cl_3\cdot NH\cdot COC_2H_5$, colourless prisms, m. p. 161°; *chloroimino*-2 : 4 : 6-*trichloropropionanilide*, $C_6H_2Cl_3\cdot NCl\cdot COC_2H_5$, pearly plates, m. p. 80°; *bromoimino*-2 : 4 : 6-*trichloropropionanilide*, $C_6H_2Cl_3\cdot NBr\cdot COC_2H_5$, bright yellow plates, m. p. 106°.

*44. "The constitution of the metallic cyanides as deduced from their synthetic interactions: the constitution of hydrogen cyanide." By J. Wade.

The formation of both nitriles and isocyanides from metallic cyanides has been explained in three ways: (1) the metallic cyanides are isocyanides, and yield isocyanides by direct interchange; nitriles are formed subsequently by isomeric change; (2) hydrogen cyanide is tautomeric and forms two classes of metallic salts (Laar); (3) the metallic cyanides are isocyanides and yield isocyanides as in (1); nitriles are formed when the metal is highly positive by the intervention of additive compounds, such as $\mathrm{K\cdot N:CI\cdot Et = KI + N\vdots C\cdot Et}$ (Nef).

Further investigation of the conditions under which isocyanides are transformed into nitriles shows that the first of the above hypotheses is inadequate. The synthetic cyanides are thus independent and primary products. The tautomerism of hydrogen cyanide does not, however, account for the facts observed; these would necessitate the tautomerism of the metallic cyanides.

The third or additive hypothesis accounts for the dual action of potassium and similar cyanides. There is no evidence, however, that the action between silver cyanide and alkyl haloids is ionic in character, nor does the hypothesis account for the different action of alkyl and acyl haloids on silver and similar cyanides.

The action of alkyl iodides on silver cyanide is parallel to their action on alkyl isocyanides, the alkyl in each case combining with the nitrogen of the cyanogen group, whereas in the action of acyl halogen compounds the acyl combines with the carbon. The alkyl radicles are feebly electropositive, the acyl electronegative; the additive power of the unsaturated carbon of the isocyanides is thus dependent not merely on the electrochemical character of the attached radicle, as Nef postulates, but on its electrochemical position relatively to the radicle of the interacting halogen compound.

When the metal or alkyl of the isocyanide is sufficiently positive with regard to the radicle of the interacting molecule, the latter combines with the carbon of the isocyanogen group, but when the two radicles are electrochemically adjacent, the interacting molecule combines with the nitrogen:

$$\left\{\begin{array}{l}
\mathrm{K\cdot N:C + EtI = K\cdot N:CI\cdot Et = KI + N\vdots C\cdot Et} \\
\mathrm{K\cdot N:C + EtKSO_4 = K\cdot N:C(SO_4K)\cdot Et = K_2SO_4 + N\vdots C\cdot Et} \\
\begin{array}{ll} + & + \\ \text{strongly} & \text{feebly} \end{array}
\end{array}\right.$$

$$\left\{\begin{array}{l}
\mathrm{Et\cdot N:C + EtI = Et.NEtI:C\ (\rightarrow NHEt_2)} \\
\mathrm{Ag\cdot N:C + EtI = Ag\cdot NEtI:C = AgI + NEt:C} \\
\begin{array}{ll} + & + \\ \text{feebly} & \text{feebly} \end{array}
\end{array}\right.$$

$$\left\{\begin{array}{l}
\mathrm{Et\cdot N:C + AcCl = Et\cdot N:CCl\cdot Ac\ (\rightarrow CH_3\cdot CO\cdot CO_2H)} \\
\mathrm{Ag\cdot N:C + AcCl = Ag\cdot N:CCl\cdot Ac = AgCl + N\vdots C\cdot Ac\ (\rightarrow CH_3\cdot CO\cdot CO_2H)} \\
\mathrm{Cu\cdot N:C + PhN:N\cdot Cl = Cu\cdot N:CCl\cdot N:NPh = CuCl + N\vdots C\cdot N:NPh} \\
\begin{array}{ll} + & - \\ \text{feebly} & \text{strongly} \end{array}
\end{array}\right.$$

The principle of this hypothesis is applicable to other similar cases of dual action.

The reactions which indicate an isocyanic constitution for hydrogen cyanide are also susceptible of an opposite interpretation. The physical and physiological properties of hydrogen cyanide also correspond with those of the nitriles.

It is probable that the metallic cyanides are, as Gautier suggested, salts of a labile hydrogen isocyanide; their relation to ordinary hydrogen cyanide or formonitrile is similar to that of the salts of Hantzsch's labile *iso*nitromethane to normal nitromethane:

$$CH_3{\cdot}NO{:}O + K{\cdot}OH = CH_3{\cdot}NO(OH){\cdot}OK = H_2O + CH_2{:}NO{\cdot}OK\ ;$$
$$H{\cdot}C{\vdots}N + K{\cdot}OH = H{\cdot}C(OH){:}NK = H_2O + C{:}NK.$$

The labile isomeride could only be made from metallic cyanides by the action of acids. These necessarily contain electronegative radicles, and therefore combine with the carbon of the cyanide, yielding the normal or nitrilic hydrogen compound:

$$K{\cdot}N{:}C + HCl = K{\cdot}N{:}CH{\cdot}Cl = KCl + N{\vdots}CH.$$

*45. "The absorption spectra of metallic nitrates. Part I."

By W. N. Hartley, D.Sc., F.R.S.

Soret was the first to observe an absorption band in solutions of nitric acid and potassium nitrate, but Soret and Rilliet did not observe it in ethyl nitrate. The author made, in 1887, an extended examination of the absorption spectra of nitrates of the simplest constitution to see if he could find any difference corresponding to that observed by Bunsen in the salts of didymium (*Pogg. Ann.*, 1866, **128**, 100).

The results obtained by the author show that the curves of nitric acid and potassium nitrate are identical, but those from silver and thallium nitrates differ widely from one another and from that of nitric acid. In the case of nitric acid, the mean position of the band primarily due to NO_3 lay between λ317 and 285. The general effect of silver nitrate is to cause an absorption of all rays beyond λ340, but there is a feeble transmission of a line about λ274. Thallium nitrate has an absorption band from λ324 to 274. With a dilution of *N*/1000, there is still an absorption of the rays about λ242, although water transmits the rays to λ211.

The solutions were examined in two ways, namely, (1) by using a fixed length of tube (200 mm.) and varying the strength of the solutions, the best results being obtained with solutions between *N*/20 and *N*/200, (2) by using normal solutions and varying the length of tube.

With normal solutions and a 200 mm. tube, nitrates of the following transmitted a strong continuous spectrum to somewhere about λ340, after which there was a complete general absorption.

H	λ346	Mg	λ357	Tl	λ340 ($N/4$)
Li	346	Ca	340	Ba	340 ($N/4$)
Na	340	Zn	346	Pb	346 ($N/2$)
K	346				
Ag	355				

46. "A method of determining the ratio of distribution of a base between two acids." By H. M. Dawson and F. E. Grant.

The method consists in shaking up an aqueous solution containing two acids and a base (the latter being insufficient for saturation of the acids) with a second liquid which is but slightly miscible with water, and which is capable of extracting one and one only of the four substances present in the solution. Tartaric, malic, succinic, and citric acids are not extracted from their aqueous solutions by chloroform, but considerable quantities of acetic acid are.

Determinations of the ratio of distribution of acetic acid between water and chloroform at 20° have been carried out, and show that this ratio increases very considerably with the dilution. By means of a diagram on which the acetic acid concentrations are plotted as abscissæ, and the distribution coefficients as ordinates, the concentration of the acid in water corresponding to any given concentration in chloroform can be readily ascertained. The influence of the presence of the salts and the second acid on the distribution ratio of the acetic acid has been investigated and found to be small.

On shaking up an aqueous solution containing soda, acetic, and tartaric acids with chloroform and determining the concentration of the acetic acid in the latter, then from the diagram the concentration of the free acetic acid in the aqueous solution can be ascertained. If the original concentrations of the base and the two acids are known, the concentrations of the free tartaric acid and of the two salts can be calculated.

The aqueous solutions were prepared in such a manner that after shaking up with an equal volume of chloroform, the base and the two acids were present in as nearly as possible equivalent quantities, the excess of acetic acid required in the original solution being determined from the preliminary distribution experiments.

Several series of experiments have been carried out in which acetic acid is compared with the several acids above mentioned, three or four concentrations being investigated in each case, and the ratios determined for the distribution of the base between acetic and each of these acids.

This method of determining the ratio of distribution of a base between two acids can also be employed where the second liquid takes up two of the components, for example, the two acids from the aqueous solution, but the ratios of distribution of the two acids between water and the second liquid must differ considerably from one another at any given concentration.

47. "On the molecular complexity of acetic acid in chloroform solution." By H. M. Dawson.

The considerable increase of the ratio in which acetic acid distributes itself between water and chloroform with increasing dilution is shown to be due to a gradual dissociation of the double molecules present in the latter solvent into simple molecules.

The limiting concentrations at which distribution experiments have been carried out correspond to an almost complete change in the molecular complexity of the dissolved acid. At a concentration of 12 grams per litre of chloroform, the acetic acid present in the form of double molecules is about five times as great as that in the form of simple molecules, whilst at a concentration of 0·1 gram per litre the proportion is only one-fifth.

The formation of double molecules by substances containing the hydroxyl group, when dissolved in liquids not containing this group, appears to be essentially dependent upon the concentration.

48. "On the existence of polyiodides in nitrobenzene solution." By H. M. Dawson and R. Gawler.

In the course of experiments on the ratio of distribution of iodine between potassium iodide solution and nitrobenzene, it was observed that as the amount of iodine added was continually increased, the concentration of the iodine in the aqueous layer reached a maximum value and then gradually decreased.

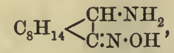
Further distribution experiments, made with a view of explaining this peculiar phenomenon, showed that the potassium iodide in the aqueous solution was extracted by the nitrobenzene on addition of iodine to the system. Using the same volumes of nitrobenzene and potassium iodide solution in successive experiments, the amount of potassium iodide thus extracted by addition of varying quantities of iodine was determined, and further, the influence of the amount of nitrobenzene for constant quantities of potassium iodide solution and of iodine was investigated. The removal of the potassium iodide by the nitrobenzene is probably due to the formation of polyiodides and the great solubility of the latter in nitrobenzene.

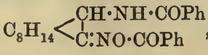
With a view of determining the nature of the polyiodides thus formed, the solubility of potassium iodide in nitrobenzene containing different quantities of iodine has been determined. If the concentration of the iodine does not exceed 0·3 gram-molecules per litre, it is found that one molecule of potassium iodide dissolves for each molecule of iodine present, indicating the formation of the triiodide. As the concentration of the solutions thus saturated with regard to potassium iodide increases, the molecular ratio of iodine to potassium iodide gradually increases and approximates to the value two.

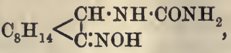
Determinations have also been made of the solubility of iodine in nitrobenzene containing potassium iodide. For all solutions containing more than sixty grams of potassium iodide per litre, the molecular ratio of the dissolved iodine to potassium iodide is equal to four, and there is some probability that this ratio holds for the more dilute solutions if the uncombined iodine present in the solution is taken into account. The results of this series of solubility determinations lead to the conclusion that the polyiodide KI_9 is present in the solution.

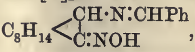
The nitrobenzene solutions have been examined with regard to their electrical conductivity, and in accordance with the high dielectric constant of nitrobenzene it is found that the solutions are good conductors. Their conductivity is approximately one-fifth that of aqueous solutions of potassium iodide of the same molecular concentration. Determinations of the freezing point of solutions of iodine in nitrobenzene, and of solutions containing in addition to iodine an equimolecular amount of potassium iodide, indicate that the triiodide is dissociated to a very considerable extent, although the difficulties of freezing point measurements with nitrobenzene as solvent prevent an accurate quantitative estimation of the degree of dissociation.

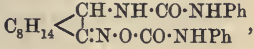
49. "Derivatives of α-aminocamphoroxime." By A. Lapworth and A. W. Harvey.

α-Aminocamphoroxime,  $C_8H_{14}<\begin{matrix}CH\cdot NH_2\\ |\\ C:N\cdot OH\end{matrix}$, is made by heating aminocamphor with a solution of hydroxylamine acetate in presence of a large excess of sodium acetate. It crystallises from benzene in flattened prisms or thin plates melting at 144—145° and dissolves in dilute alkalis and acids. It has $[\alpha]_D = +60·5°$ in a 1 per cent. solution in absolute alcohol and +36·7° in dilute acids. The *hydrochloride*, $C_{10}H_{18}N_2O_8,HCl,H_2O$, forms small prisms and has $[\alpha]_D = +28·3°$ in water. The *platinichloride*, $(C_{10}H_{19}N_2O)_2PtCl_6$, forms yellow needles melting and decomposing at 209—211°.

The *dibenzoyl* derivative,  $C_8H_{14}<\begin{matrix}CH\cdot NH\cdot COPh\\ |\\ C:NO\cdot COPh\end{matrix}$, crystallises in brilliant prisms which melt at 146—147°. In absolute alcohol $[\alpha]_D = +104\cdot8°$.

The *carbamide*,  $C_8H_{14}<\begin{matrix}CH\cdot NH\cdot CONH_2\\ C{:}NOH\end{matrix}$, crystallises in two forms, which appear, however, to melt and decompose at the same temperature, namely, 203—204°. It has $[\alpha]_D = +40\cdot9°$ in absolute alcohol.

The *benzylidene* compound,  $C_8H_{14}<\begin{matrix}CH\cdot N{:}CHPh\\ C{:}NOH\end{matrix}$, prepared by the interaction of the oxime with benzaldehyde in alcoholic solution, forms brilliant, transparent, apparently hemimorphic prisms melting at 153—154°. In alcohol $[\alpha]_D = 226\cdot9°$.

Aminocamphoroxime unites with two molecular proportions of phenylcarbimide, forming a *compound*,  $C_8H_{14}<\begin{matrix}CH\cdot NH\cdot CO\cdot NHPh\\ C{:}N\cdot O\cdot CO\cdot NHPh\end{matrix}$, which crystallises in asbestos-like needles melting at 175—177°. In absolute alcohol $[\alpha]_D = -56\cdot6°$.

The products obtained by the action of heat or of dehydrating agents, such as acetyl chloride, upon aminocamphoroxime do not appear to contain any compound corresponding with the campholenonitriles.

50. "Preparation of sulphamide from ammonium amidosulphite."

By E. Divers and M. Ogawa.

It has been pointed out by the authors (*Trans.*, 1900, **77**, 324) that a substance, apparently sulphamide, is one of the products of decomposition of ammonium amidosulphite. They have since proved that this substance is sulphamide, and that ammonium amidosulphite is a much better source of it than sulphuryl chloride has been found to be by Hantzsch and Holl (*Ber.*, 1901, **34**, 30). The yield is 10 per cent. or more, and it is accompanied by no substances which are difficult to remove. Ammonium amidosulphite is slowly heated to, and then maintained at, a temperature of about 70°, so as first to decompose the salt and then to destroy much of the thionic compounds which accompany the sulphamide. The product is dissolved in water and practically everything but ammonium amidosulphate separated from the sulphamide by treating the solution with barium hydroxide and with silver nitrate. With some simple precautions, necessitated by the presence of the amidosulphate, the sulphamide is precipitated as silver salt and recovered from this, almost as Traube directs.

51. "Hypoiodous acid." By R. L. Taylor.

It has been concluded by Orton and Blackman (*Trans.*, 1900, **75**, 830) that "the solutions obtained from iodine and mercuric oxide contain only a small quantity of hypoiodite, and that the iodine is chiefly present as iodate." This is contrary to the results described by the author in a former paper (*Mem. Manchester Phil. Soc.*, 1897, **41**, 8), where he used aqueous iodine (1 part in 5000) and obtained 80 to 90 per cent. of the possible amount of hypoiodite. He has made further experiments and finds that the proportion of iodine existing in the filtrate as hypoiodous acid increases with the fineness of division of the iodine, and diminishes as the proportion of iodine to the water employed increases and with the time occupied in shaking and filtering. Using powdered iodine, about 2 parts to 1000 of water, and occupying (as Orton and Blackman did) 15 minutes in shaking and 10 minutes in filtering, the author obtains results not very different from theirs; but using *precipitated* iodine with the same proportion of water and taking only a little over a minute in shaking and filtering, the filtered liquid contains 44 to 52 per cent. of the possible amount of iodine as hypoiodous acid, and of the total iodine in the filtered liquid 90 to 95 per cent. exists as hypoiodous acid and only 5 to 10 per cent. as iodic acid. The solution of hypoiodous acid decomposes very rapidly, beginning to turn brown, owing to the liberation of iodine, almost immediately after filtering, unless a very dilute solution of iodine has been employed. Consequently it is impossible to obtain good results unless all the operations are performed very quickly. The filtered liquid always contains a little mercury. The author has estimated this, and finds that although the hypoiodite in the filtrate may exist partly as mercuric hypoiodite, there is so little mercury present that a considerable proportion of the iodine must exist as hypoiodous acid.

52. "Synthesis of imino-ethers. *N*-aryl benzimino-ethers." By G. D. Lander.

The preparation of imino-ethers of the type $Ph\cdot COR{:}NPh$ from the imide chlorides of the corresponding benzoyl arylamines was described. The reaction between the imide chlorides and sodium alcoholates occurs most readily when the latter are employed in alcoholic solution. Intramolecular rearrangement does not take place in the formation of the methyl compounds.

N-*phenylbenziminoethyl ether*, $C_6H_5C(OEt){:}NC_6H_5$, boils at 168—170° at 14 mm.; the *methyl* compound at 157—158° at 12 mm., and the n-*propyl* ether at 177—179° at 11 mm.

As a bye-product in the syntheses of the methyl and ethyl ethers, benzoyldiphenylbenzenyl amidine, $C_6H_5C{:}NC_6H_5{\cdot}N(COC_6H_5)C_6H_5$, yellow prisms of m. p. 170—172°, was detected.

N-o-*tolylbenziminoethyl ether*, $C_6H_5C(OEt){:}NC_7H_7$, boils at 179—180° at 15 mm., the *methyl* ether at 173° at 15 mm.

N-p-*tolylbenziminoethyl ether* boils at 178° at 11 mm., the *methyl* ether at 177° at 12 mm.

Reference was made to the formation, by the action of acetyl chloride containing hydrochloric acid on a light petroleum solution of the base, of the hydrochloride of *N-o*-tolylacetiminoethyl ether, $CH_3C(OEt){:}NC_7H_7,HCl$, which is crystalline, melts at 109—110°, and decomposes into ethyl chloride and acetotoluidide. Similarly, N-*phenylacetiminoethyl ether hydrochloride*, $CH_3C(OEt){:}NC_6H_5,HCl$, m. p. 100° with decomposition, has been prepared for the first time.

*53. "Nitration of *s*-trihalogenacetanilides." By K. J. P. Orton.

As a sequel to the author's work on the action of nitric acid on *s*-trihalogenanilines (this vol., p. 58) the nitration of *s*-tribromoacetanilide and of 4-chloro-2 : 6-dibromoacetanilide has been investigated. Remmers (*Ber.*, 1874, 7, 351) and Bentley (*Amer. Chem. Jour.*, 1898, 20, 472) have subjected *s*-tribromoacetanilide to the action of fuming nitric acid; the former obtained an anilide, $C_6HBr_3(NO_2)NHAc$, crystallising in yellow needles from which an aniline, $C_6HBr_3(NO_2){\cdot}NH_2$, was prepared by hydrolysis with ammonia; it crystallised in yellow needles and melted at 214—215°, whilst 2 : 4 : 6-tribromo-3-nitroaniline, according to Körner (*Jahresbericht*, 1875, 347), melts at 102·5°. Bentley was unable to confirm Remmer's results.

By cautiously warming the anilides above mentioned with fuming nitric acid, the author has obtained respectively 2 : 4 : 6-tribromo-3-nitroacetanilide and 4-chloro-2 : 6-dibromo-3-nitroacetanilide. In neither case was the nitration complete; the nitrated anilide was isolated in a pure state by conversion of the mixture of anilides into the acetylchloroamino-derivatives; the latter can be readily separated by fractional crystallisation from petroleum, in which the nitrated chloroamine (for example, acetylchloroamino-2 : 4 : 6-tribromo-3-nitrobenzene) is but little soluble. By treatment with alcohol, the anilide is obtained from the pure acetylchloroamino-derivative.

The following substances have been prepared:

2 : 4 : 6-*Tribromo-3-nitroacetanilide*, $C_6HBr_3(NO_2)NHAc$, from 2 : 4 : 6-tribromo-3-nitroaniline (m. p. 102°, Körner), and by nitrating *s*-tribromoacetanilide, colourless needles, m. p. 216—217°; 2 : 4 : 6-*tribromo-3-nitrodiacetanilide*, $C_6HBr_3(NO_2){\cdot}NAc_2$, rhombs, m. p. 175—176°;

acetylchloroamino-2 : 4 : 6-*tribromo-3-nitrobenzene*, $C_6HBr_3(NO_2)NClAc$, prisms, m. p. 159°.

4-*Chloro*-2 : 6-*dibromo-3-nitroaniline*, $C_6HClBr_2(NO_2)\cdot NH_2$, prepared by brominating 4-chloro-3-nitroaniline (m. p. 103°), and by hydrolysis of the corresponding anilide, pale yellow needles, m. p. 103—104°.

4-*Chloro*-2 : 6-*dibromo-3-nitroacetanilide*, $C_6H\cdot ClBr_2(NO_2)\cdot NHAc$, prepared from the corresponding aniline and by nitrating 4-chloro-2 : 6-dibromoacetanilide, silky needles, m. p. 224°; *acetylchloroamino*-4-*chloro*-2 : 6-*dibromo-3-nitrobenzene*, $C_6HClBr_2(NO_2)\cdot NClAc$, short prisms, m. p. 134—135°.

Attention is called to the fact that, whereas in the action of nitric acid on *s*-tribromoaniline a nitroamine is first formed, which then undergoes change, the nitro-group displacing the para-bromine atom in the nucleus (this vol., p. 58), with the anilide no such displacement occurs, but only nitration in the meta-position. Acetylation, combined with the presence of two ortho-placed halogen atoms, prevents partially, at least, the amino-group from exercising its usual directing function.

54. "Purpurogallin. Preliminary Notice." By A. G. Perkin and A. B. Steven.

To purpurogallin, an oxidation product of pyrogallol, Clermont and Chautard (*Jahresbericht*, 1882, 683) assigned the formula $C_{20}H_{16}O_9$, and described a tetra-acetyl compound, $C_{20}H_{12}O_9(C_2H_3O)_4$, m. p. 186°, and a tetrabromo-derivative, $C_{20}H_{12}Br_4O_9$, m. p. 202—204°. Nietzki and Steinmann (*Ber.*, 1887, **20**, 1278) preferred the formula $C_{18}H_{14}O_9$, and found that on distillation with zinc dust naphthalene is produced. This preliminary investigation, while corroborating, as a rule, the analytical numbers of these chemists, indicates that the molecular weight of purpurogallin is much lower, most probably being represented by $C_{11}H_8O_5$. The *tetra-acetyl* compound, m. p. 182—183°, $C_{11}H_4O_5(C_2H_3O)_4$, and the *tribenzoyl* compound, $C_{11}H_5O_5(C_7H_5O)_3$, minute colourless prisms, m. p. 213° (found $C = 71.99$; $H = 3.86$; molecular weight [cryoscopic] = 556), have been studied. Analyses of the *dibromo*-compound, $C_{11}H_6Br_2O_5$, m. p. 204—206° (found $C = 35.10$; $H = 1.67$), and the *monopotassium* salt, $C_{11}H_7O_5\cdot K$ (found $K = 14.76$) minute, brown-violet needles, point to the correctness of this formula. Hooker (*Ber.*, 1887, **20**, 3260), by means of nitrous acid, obtained purpurogallin from gallic acid. If, however, potassium ferricyanide in conjunction with potassium acetate be employed, a small quantity of a new compound crystallising in minute, orange-red needles is formed, which appears to be purpurogallin carboxylic acid, $C_{11}H_7O_5 \cdot CO_2H$ (found C = 54·56, 54·14; H = 3·73, 3·18).

55. "Quercetagetin." By A. G. Perkin.

Quercetagetin was isolated from the flowers of the African marigold (*Tagetes patula*) by Latour and Magnier de la Source (*Bull. Soc. Chim.*, 1877, **28**, 337) as a yellow, crystalline substance, $C_{27}H_{22}O_{13} + 4H_2O$. A reinvestigation indicates that its true formula is $C_{15}H_{10}O_8$ (found C = 56·66, 56·47; H = 3·25, 3·31), as it gives a *sulphate*, $C_{15}H_{10}O_8,H_2SO_4$ (found C = 43·28; H = 3·29), orange needles, and a *monopotassium* salt, $C_{15}H_9O_8K$ (found K = 10·74). Quercetagetin melts at 318—320°, gives an *acetyl* compound, $C_{15}H_4O_8(C_2H_3O)_6$ (found C = 57·37; H = 3·87; $C_{15}H_{10}O_8$ = 55·82), colourless needles, m. p. 203—205°, and dyes shades browner, though somewhat similar to quercetin, to which class of colouring matter it appears to belong. It contains no methoxyl group and on fusion with alkali gives protocatechuic acid and a phenol at present unidentified. As there is considerable difficulty in obtaining raw material, the conclusion of the investigation may be delayed for some time.

ADDITIONS TO THE LIBRARY.

I. By Donation.

Lewkowitsch, Julius. The laboratory companion to fats and oils industries. Pp. 147. London 1901. From the Author.

Lewkowitsch, Julius. Laboratoriumsbuch für die Fett- und Öl-industrie. Pp. 148. Braunschweig 1902. From the Author.

II. Purchase.

Engelhardt, Viktor. Die Elektrolyse des Wassers, ihre Durchführung und Anwendung. Pp. 117. Halle-a-S. 1902.

Hofmann, Reinhold. Ultramarin. Pp. 154. Braunschweig 1902.

III. Pamphlets.

Class list and index of the Periodical Publications in the Patent Office Library. Pp. 191. London 1902.
From the Comptroller-General of Patents.

Fowler, Gilbert J. Some points in the management of septic tanks and bacterial contact beds. Pp. 11. London. From the Author.

Tankard, Arnold R. Artificial silk (Lecture delivered before the Sheffield Microscopical Society). Pp. 15. From the Author.

ANNUAL GENERAL MEETING

The Annual General Meeting of the Society for the election of Officers and Council, and for other business, will be held on **Wednesday**, March 26th, at **half-past four** o'clock in the afternoon.

RAOULT MEMORIAL LECTURE.

The Raoult Memorial Lecture will be delivered by Professor van't Hoff, on **Wednesday**, March 26th, at **9** p.m.

This lecture will be delivered, by kind permission of the Managers, in the Theatre of the Royal Institution, 21, Albemarle Street, W.

Admission will be by ticket only. Each Fellow of the Society will be entitled to two tickets, which may be obtained on application to the Assistant Secretary, Chemical Society, Burlington House.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 250.

March 26th, 1902. Annual General Meeting. Professor EMERSON REYNOLDS, Sc.D., V.P.R.S., President, in the Chair.

Dr. HENRY and Mr. RAMAGE were appointed Scrutators, and a ballot was opened for the election of Officers and Council for the ensuing year.

The PRESIDENT, in beginning his address, said that he had the agreeable duty of congratulating the Fellows on the continued and ever increasing prosperity of the Society.

The numerical strength of the Society was 2335 on March 28th, 1901. Since that date 163 Fellows had been elected, and 3 had been reinstated by the Council, making a gross total of 2501. Of these, 32 had withdrawn, 25 had been removed for non-payment of two annual subscriptions, and 21 had died.

The actual number of Fellows to date was therefore 2423, the highest number yet reached, and the number of Foreign Members was 32.

The names of those removed for non-payment of subscriptions were :—

E. W. Allsom, W. D. Bohm, C. F. Branson, T. H. Coleman, E. D. Ewen, F. G. Fuller, C. H. Field, W. G. Fraser, A. T. Gailleton, W. H. Grieve, T. C. Hepworth, A. F. Hogg, J. Harger, W. Ince, R. S. Ladell, R. D. Littlefield, D. C. Mackenzie, A. Mackay, F. L. Overend, M. Pearson, S. Smith, A. H. Turton, C. W. Vincent, W. H. Walker, A. Walton.

The following have withdrawn :—

J. M. Arnot, W. H. Barr, F. Belton, H. D. Berridge, M. Cochran, W. Collingridge, J. Craig, H. L. Dampier, M. J. R. Dunstan, G. Evans,

H. P. FitzGerald, P. H. Grant, W. H. Greene, H. W. Gough, A. B. Griffiths, J. B. Guyer, H. M. Hastings, E. S. Hayward, A. H. Macdonald, C. J. S. Makin, J. Maudsley, J. McLeod, H. C. Myers, G. A. Parkes, L. G. Patterson, J. C. Quinn, A. Schloesser, C. Thompson, E. A. Wates, J. I. Whimster, B. W. Winder, S. Wood.

The following have died :—

F. J. Beale, J. H. Beckett, Henry Bird, Sir J. H. Gilbert, F.R.S., A. Hartridge, Alexander Hay, Lawrence Hislop, David Johnson, N. Leonard, H. G. Madan, Dr. Ira Moore, Dr. G. Harris Morris, John Paul, W. Shapleigh, Louis Siebold, Prof. Maxwell Simpson, F.R.S., W. T. N. Spivey, W. Terrill, John Thomson, J. L. W. Thudichum, G. F. Wilson, F.R.S.

The most important test of the prosperity of the Society was, however, to be found in the record of its work. In this respect also he had a favourable report to make. Since the last anniversary, 181 communications had been made to the Society. Abstracts of all these had appeared in the *Proceedings*, whilst 139 had already been published in the *Transactions*. He ventured to think that the quality, generally, of the work presented was as high as in any previous year, and clearly indicated the continued enthusiasm and activity of the Fellows.

The *Transactions* for 1901 contained 146 memoirs, occupying 1411 pages; and the volume of the preceding year 127 memoirs occupying 1334 pages.

The volumes for 1901 contain 3754 abstracts of papers, published mainly in Continental journals, occupying 1496 pages, arranged as follows :

	Pages.	No. of Abstracts.
PART I.		
Organic Chemistry	784	1530
PART II.		
General and Physical Chemistry		403
Inorganic Chemistry		376
Mineralogical Chemistry		169
Physiological Chemistry		363
Chemistry of Vegetable Physiology and Agriculture		306
Analytical Chemistry		607
	712	2224
Total in Parts I. and II.	1496	3574

The volume for 1901 contained a Memorial Lecture giving an account of the life-work of Rammelsberg. A set of the Memorial Lectures which had appeared up to the end of 1900 was issued in September last in a separate form.

The use of the Library by the Fellows continued to show their appreciation of it. Eight hundred and eighty books had been borrowed, as against 810 during the corresponding period of last year. A large number of these were Journals issued by post to Fellows resident in the country, and the Library Committee invited special attention to this development of the Society's usefulness. The additions to the Library comprised 153 books, 441 volumes of periodicals, and 33 pamphlets as against 95 books, 327 volumes of periodicals, and 30 pamphlets during the corresponding period of last year.

It was desirable that the Society should have in the Library a copy of, at least, every work printed in English on chemical subjects to the end of the 18th century, and he would invite the co-operation of the Fellows in making the Library complete in this direction.

In the preparation of the new Library catalogue, the printing of which had been decided upon, advantage was taken of the opportunity to construct a new and convenient Card Catalogue, which, it was believed, would materially assist readers in making use of the Library.

It was his privilege to offer, on behalf of the Society, its warm congratulations to Dr. Schunck, to Mr. Lloyd Bullock, and to Dr. Francis, who this year have reached their sixtieth anniversary of admission to the Fellowship of the Society. He had pleasure to add that Mr. Buckton, F.R.S., Mr. F. Claudet, and Mr. Darby have reached their jubilee, and to them he would also convey its sincere congratulations.

Last year their illustrious senior Foreign Fellow, M. Berthelot, celebrated the fiftieth anniversary of his first scientific publication, and all countries united in expressing their admiration and respect for the veteran chemist. On behalf of the Society, he, with Dr. Gladstone and Professor Ramsay, presented a congratulatory address to M. Berthelot at the imposing function which was held in the Sorbonne on November 24th, 1901. This address had already been printed in the *Proceedings*.

During the year, the Society had joined in the celebration of the 450th anniversary of Glasgow University, and in the jubilee of Owens College, Manchester.

Considering the large number of Fellows now in the Society, the mortality is small; nevertheless, this year they had to regret the loss of 21 Fellows. This melancholy list includes the name of Sir Henry Gilbert, Past President of this Society, and one ever devoted to its welfare. His immense work, carried out with Sir John Lawes, laid the scientific foundation of British Agriculture and serves as the model on which all future researches must proceed. The Society was fully represented on the sad occasion when Sir Henry Gilbert was interred, and its representatives laid a wreath on his grave, while later on the Council passed a vote of condolence with his mourning relatives. In a short time, he hoped, a full obituary notice would be published by one far more competent to undertake it than he. Dr. Maxwell Simpson is another of those passed away from amongst us, full of years, leaving memories of good work well done, especially in synthetic chemistry, and of him and of the other Fellows whose life-work has closed records will also be shortly published.

Considerable discussion had taken place within the Society on the question of altering the day and hour of the Ordinary Meetings, which was raised in the address of his predecessor, Dr. Thorpe, last year. They had had two Extraordinary Meetings on this subject, and the outcome was the experiment now in operation, of trying alternate evening and afternoon Meetings until the end of the present session. Until that experiment had been fairly made, the best course, obviously, was to suspend judgment on the question.

Grants amounting to £250 had been made from the Research Fund in aid of chemical investigations.

The remainder of the address dealt with certain aspects of the periodic law as modified by recent discovery.

Dr. GLADSTONE, F.R.S., proposed a vote of thanks to the President, coupled with the request that he would allow his address to be printed in the *Transactions*.

Dr. THORPE, C.B., F.R.S., seconded the motion, which was carried by acclamation.

The PRESIDENT having returned thanks,

Prof. TILDEN, F.R.S., the Treasurer, in giving an account of the Balance Sheet which he laid before the Society, duly audited, said :—

The receipts had been :—By admission fees and subscriptions, £4532 ; by sale of Journal and advertisements, £835 11*s.* 2*d.* ; and by dividends on invested capital, £476 12*s.* 6*d.* The total receipts from all sources amounted to £5884 1*s.* 8*d.* The expenses had been : —On account of the Journal, £3233 0*s.* 2*d.* ; on account of the Proceedings, £20 1*s.* 5*d.* ; on account of the Library Catalogue, £42 14*s.* 4*d.* ; on account of the Library, £429 15*s.* 5*d.* ; House expenses, £239 19*s.* 1*d.* ; the total expenditure being £4913 10*s.* 6*d.*

The TREASURER, in concluding, proposed a vote of thanks to the auditors, which was acknowledged by Mr. CHAPMAN.

Prof. H. B. DIXON, F.R.S., proposed a vote of thanks to the Treasurer, Secretaries, and Council.

Dr. HEWITT seconded the motion, which was unanimously adopted. Prof. MELDOLA, F.R.S., responded.

The Scrutators having presented their report to the President, he declared that the following had been duly elected :—

President: J. Emerson Reynolds, Sc.D., M.D., V.P.R.S.

Vice-Presidents who have filled the office of President: Sir F. A. Abel, Bart., K.C.B., D.C.L., F.R.S.; H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; J. Dewar, M.A., LL.D., F.R.S.; J. H. Gladstone, Ph.D., D.Sc., F.R.S.; A. G. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S,; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: E. Divers, M.D., D.Sc., F.R.S.; P. F. Frankland, LL.D., F.R.S.; H. McLeod, F.R.S.; R. Meldola, F.R.S.; H. A. Miers, D.Sc., F.R.S.; T. Stevenson, M.D.

Secretaries: W. R. Dunstan, M.A., F.R.S.; A. Scott, M.A., D.Sc., F.R.S.

Foreign Secretary: W. Ramsay, LL.D., F.R.S.

Treasurer: W. A. Tilden, D.Sc., F.R.S.

Other Members of Council: H. B. Baker, M.A.; F. D. Chattaway, Ph.D., D.Sc.; F. Clowes, D.Sc.; J. J. Dobbie, M.A., D.Sc.; A. E. Dixon, M.D.; M. O. Forster, Ph.D., D.Sc.; A. Harden, M.Sc., Ph.D.; J. Lewkowitsch, Ph.D.; J. E. Marsh, M.A.; S. U. Pickering, M.A., F.R.S.; J. A. Voelcker, Ph.D.; J. Walker, D.Sc., F.R.S.

March 26th, 1902. Extra Meeting. Professor EMERSON REYNOLDS, Sc.D., V.P.R.S., President, in the Chair. This meeting was held in the Theatre of the Royal Institution, by kind permission of the Managers.

Professor J. H. VAN'T HOFF, F.R.S., delivered the Raoult Memorial Lecture.

François Marie Raoult was born on May 10th, 1830, at Fournes, in the Department of Nord. When he went to Paris to pursue his studies he had neither fortune nor patronage to assist him, so had to struggle to find means to keep himself. His first paper, published in 1853, contained observations on the transport of electrolytes by the galvanic current and on electrical endosmosis. In 1853 he was appointed "Aspirant repétiteur" in the Rheims Lycée, in 1855 "Régent de Physique" in the college at St. Dié, after which he was again at Rheims, and in 1860 at Bar-le-Duc, employing his spare time in working for his degree of *Licencié ès-Sciences physiques.* In 1862, he proceeded to Sens, where, amidst adverse material surroundings, he prepared his thesis on Electromotive Force, for which in 1863 he obtained in Paris the degree of *Docteur ès-Sciences physiques.*

The work of Raoult may be divided into three distinct parts: the physical, the chemical, and the physico-chemical. His career as a physicist begins with the thesis above referred to, by which he was marked out as an accurate and independent investigator already in advance of his time by the conclusions he based on a careful examination of facts. In the first part of this research he measured and compared in the cells of the Daniell type the amount of heat due to the chemical action with that corresponding to the electrical work produced, and showed that they were by no means identical. The second part was devoted to the decompositions in the voltameter by the galvanic current, the thermal phenomena being especially studied. It was whilst carrying out his electro- and thermo-chemical investigations that Raoult entered the *Faculté des Sciences de Grenoble* in 1867 as "chargé du cours de Chimie," being promoted in 1870 to the Chair of Chemistry, which he occupied until his death last year.

From this time forward a change is visible in the direction of Raoult's work, which now became of a more purely chemical kind, the problems still being looked at from the physical point of view. These problems included the examination of the gas from a "fontaine ardente," which he showed to be merely methane, the proof of presence of copper and zinc as normal constituents of the human liver, the inverting action of light on sugar. He showed that the presence of carbon dioxide in air diminished the production of carbon dioxide in the lungs, but that this effect was counteracted by the increased pulmonary action. His discovery of a basic calcium carbonate, $CaCO_3,CaO$, which acts like plaster of Paris on the addition of water, formed the subject of his last purely chemical paper. After this, he definitely enters upon that line of research which he has made peculiarly his own, and in which he persevered until his death.

His first paper on freezing points was published in 1878 and was of a purely empirical nature, pointing out the proportionality existing between the lowering of the freezing point and that of vapour pressure (or raising of boiling point). Probably owing to the difficulty of determining the strength of alcoholic liquors by means of their vapour pressures or boiling points, he tried their freezing points. How this was related to practical applications is shown by the table appended to the paper, the liquids beginning with cider and ending with Marsala, the freezing points varying from $-2°$ to $-10·1°$, and corresponding fairly with the proportion of alcohol. From solutions of ethyl alcohol he passed to those of other alcohols, and thence to other organic compounds, giving his well known table relating to twenty-nine substances. His conclusion was that the product of the depression of freezing point of a solution containing 1 gram of substance in 100 grams of water multiplied by the molecular weight of the dissolved substance is a constant. Two further papers in 1882 extended the freezing point law to solvents other than water, and he showed that each solvent has its own molecular constant which, probably by the formation of double molecules of the dissolved substance, may be reduced to half the normal value. This constant is proportional to the molecular weight of the solvent (M_1) and is on an average $\frac{K}{M_1} = 0·62$. From organic compounds he passed to the more difficult cases of salt solutions, beginning with those of acids and bases and finding that strong monobasic acids like hydrochloric acid and strong mono-acid bases like potassium hydroxide have a molecular depression of 37 whilst the weaker ones, like organic compounds, have only 18·5. He summed up his results thus: "These facts prove that, in opposition to what I had admitted up till now, the general law does not apply to dissolved salts; on the contrary they tend to indicate that it is applicable to the constituent radicles of the salts, almost as if these radicles were simply mixed in the solutions."

The early work of Raoult on voltaic cells was neglected, as it was much before its time, but his work on cryoscopy appeared just in the nick of time and was soon warmly received everywhere. In 1892 he again took up his study of freezing points which had been interrupted in 1884, but now from the point of view of the new theory of solutions, and showed that the molecular depressions of potassium chloride and sugar, as well as of sodium chloride and alcohol, were in accordance with the hypothesis of Arrhenius. In his summary of work in this direction, Raoult admitted all the conclusions of the theory of solutions, but as a thoroughly experimental investigator he objected to build upon that large but hypothetical generalisation known as the extended Law of Avogadro.

The relations existing between lowering of freezing point and of vapour pressure led Raoult to his tonometric work. He found (as Wüllner had already proved in some cases) that the ratio existing between the lowering of the pressure $(f-f')$, and the pressure itself (f), namely, $\frac{f-f'}{f}$, the so-called *relative lowering* of pressure was independent of the temperature. His next step was to determine the values of the *molecular relative lowering.* He thus formulated what he found: "One molecule of a non-volatile substance (salts excepted) dissolving in 100 molecules of any volatile liquid, diminishes the vapour pressure of that liquid by an almost constant fraction of its value, which is about 1·05 per cent." This conclusion at once brought him into connection with the theory of solutions, and Raoult himself says of it, in 1887, that "the agreement between experiment and theory is thus in all respects as complete as one can desire in such matters." In 1893, along with Recoura, he gave his most general and exact expression of the results of his vapour pressure observations.

Raoult's constitution seems to have been a vigorous one, the only indication to the contrary being his resignation, in 1892, of an additional professorship which he had held. He ought to have retired in April, 1900, on account of his having reached the age limit for the tenure of his chair, but by special decision of the Trustees he remained in office "hors cadre," a very high honour, and a proof of his unbroken vigour at that time. In his last year, in two comprehensive papers, he summed up his views on Tonometry and on Cryoscopy; it was just in time, for, with practically no premonitory symptoms, he died on April 1st, 1901.

His character as a man may be read in his papers, in which he showed activity, patience, tenacity in pursuing an aim, as much eye for detail as for the vaster horizon, absolute independence of mind, criticising or admitting without bias views of others as well as his own, and testing both with the same calm conviction that the last word must rest with experiment.

Prof. ODLING in proposing a vote of thanks to Prof. van't Hoff, said that he would not add a word to the appreciative, unaffected, and simple account of the work of Raoult. It was so lucid and complete that coming from any one it would have been of great interest, but in this case, coming from Prof. van't Hoff, it gave all the greater pleasure. Prof. van't Hoff's work in inorganic chemistry had exercised a very great influence on modern chemical doctrine for a quarter of a century; his work had excited a high degree of interest amongst English chemists, and to-night he had supplemented their acquaintance with his work by giving them the opportunity of making acquaintance with himself. The early work of Prof. van't Hoff did not, and very properly so, win its way without some opposition, which in certain continental schools was unduly harsh. As with his theory of the chemical atom in space, so is it with the doctrine of osmotic pressure and the philosophy of solution. He could assure Prof. van't Hoff that in no country had these been received with greater favour than in this, in spite of opposition more vivacious than weighty. They were accepted if not as the final truth, if the truth at all, at any rate as running on all fours with the truth.

The vote of thanks was seconded by Prof. DEWAR, and supported by Sir WILLIAM HUGGINS, President of the Royal Society.

Thursday, April 17th, 1902. Professor TILDEN, D.Sc., F.R.S., Treasurer, in the Chair.

Messrs. Davis, Dorée, Aders Plimmer, Allworthy, and Bedwell were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :
Clough, William Thomas, 3, Watford Villas, Battersea Park, S.W.
Davis, Henry Wilson, 18, Crescent Road, Kingston Hill, Surrey.
Hallowell, Thomas Butterworth, New Mills, Derbyshire.
Lessner, Charles B., 46, Broadfield Road, Hither Green, S.E.
Moore, Thomas Henry, 19, Sandmere Road, Clapham, S.W.
Rây, Prafulla Chandra, Calcutta, India.
Skertchly, William Pearson, 11, Billiter Square, E.C.
Stewart, Hector, 479, Collins Street, Melbourne.
Wells, William John, Springburn, Blackburn.
West, Joseph, 50, Poplar Grove, Fenton, Stoke-on-Trent.

Of the following papers those marked * were read :—

*56. "Dimercurammonium nitrite and its haloid derivatives."

By P. C. Rây.

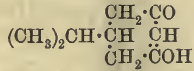
Some account has already been given (*Proc.*, 1901, **17**, 96) of the investigation which is here more fully and accurately described. Mercurous nitrite partly decomposes in dissolving in water, giving metallic mercury and a solution of both mercuric and mercurous nitrites (*Trans.*, 1897, **71**, 337). Adding to this solution just enough sodium chloride and filtering, there is left a solution of mercuric sodium nitrite, which gives, with excess of ammonia, a white precipitate of a new salt, $2NHg_2NO_2,H_2O$, dimercurammonium nitrite. On dissolving it in hydrochloric acid and evaporating, there is left a new mercuric ammonium chloride, $2HgCl_2,NH_4Cl$, a white, crystalline, volatile, and fusible salt. The corresponding bromide can be obtained in a similar way, as well as by evaporating a hydrobromic acid solution of the single bromides in the right proportions; it is largely decomposed by water into its component salts. With potassium hydroxide, not in excess, these double salts give dimercurammonium chloride and bromide, $2NHg_2Cl,HgCl_2$, and $2NHg_2Br,HgBr_2$, the former not quite pure. With excess of potassium hydroxide, they yield the half-hydrated dimercurammonium chloride and bromide, $2NHg_2Cl,H_2O$ and $2NHg_2Br,H_2O$, the former already described by André.

When either dimercurammonium chloride or bromide is dissolved in hydrobromic acid, the above-formulated mercuric ammonium bromide is obtained on evaporation; when dimercurammonium bromide is dissolved in hydrochloric acid, a mercuric ammonium chlorobromide, $2HgCl_2,NH_4Br$, is left on evaporation. From this chlorobromide, potassium hydroxide reproduces quantitatively dimercurammonium bromide, a fact which led the author at first to regard the chlorobromide as dimercurammonium bromide in union with 4 molecules of hydrochloric acid, and the corresponding double chloride and double bromide as $NHg_2Cl,4HCl$, and $NHg_2Br,4HBr$, respectively.

The author considers that the chemical composition of dimercurammonium nitrite and its derivatives gives much support to the Rammelsberg-Pesci theory of the dimercurammonium constitution of all ammoniated mercury salts.

*57. "Preparation and properties of 4-*iso*propyldihydroresorcin. A correction." By A. W. Crossley.

The nomenclature adopted in the preliminary notice of this work (*Proc.*, 1901, 17, 172) has been changed. The substance there spoken of as 2 : 6-diketo-4-*iso*propylhexamethylene is now called 4-iso*propyldihydroresorcin*, for though this and other similar substituted dihydroresorcins behave as diketones towards hydroxylamine, there can be no doubt that their most usual form is the keto-enol modification represented by the following formula:



$$\begin{array}{rl} & CH_2\cdot CO \\ (CH_3)_2CH\cdot & CH \quad CH \\ & CH_2\cdot COH \end{array}$$

*58. "Oxonium salts of fluoran and its derivatives." By J. T. Hewitt and J. N. Tervet.

Fluoran (the phenolphthaleinanhydride of Baeyer) and some of its derivatives have been examined as to their power of forming salts with strong mineral acids. The following salts have been prepared and examined: *Fluoran nitrate*, $C_{20}H_{12}O_3,HNO_3$; *monosulphate*, $C_{20}H_{12}O_3,H_2SO_4$; *dimethylfluoran nitrate*, $C_{22}H_{16}O_3,HNO_3$; *dimethylfluoran monosulphate*, $C_{22}H_{16}O_3,H_2SO_4$; *dimethylfluoran disulphate*, $C_{22}H_{16}O_3,2H_2SO_4$; *fluorescein hydrochloride*, $C_{20}H_{12}O_5,HCl$; *fluorescein monosulphate*, $C_{20}H_{12}O_5,H_2SO_4$; *fluorescein disulphate*, $C_{20}H_{12}O_5,2H_2SO_4$.

*59. "Influence of substitution on the reactivity of the aromatic metadiamines." By G. T. Morgan, D.Sc.

The successive introduction of methyl groups into the three positions adjacent to the nitrogen atoms of *m*-phenylenediamine is attended by a well-marked diminution in the reactivity of the diamine towards methylating agents, the action of methyl chloride or bromide being prevented when the substitution of the three hydrogen atoms is complete.

m-Tolylenediamine (2 : 4-diaminotoluene), like *m*-phenylenediamine, gives rise to a mixture of tertiary base and quaternary salt; 4 : 6-diamino-*m*-xylene yields the tertiary base as the sole product, whilst diaminomesitylene is not affected.

These results agree with those obtained by Pinnow (*Ber.*, 1897, **30**, 3110; 1899, **32**, 1401; 1901, **34**, 1129), and also by E. Fischer and Windaus (*Ber.*, 1900, **33**, 345 and 1967).

The tertiary diamines containing one free para-ortho-position with respect to nitrogen are very reactive substances, darkening on exposure, yielding unstable platinichlorides, and interacting readily with formaldehyde and the diazonium salts.

4 : 6-*Tetramethyldiamino-*m*-xylene*, which contains methyl groups in each of the para-ortho-positions, is a comparatively inert substance which is not darkened by exposure to light or air; its *platinichloride* is stable, and the base itself does not condense either with formaldehyde or diazonium salts. This diamine boils at 243—245° under 757 mm., and at 124—125° under 12 mm. pressure; its *picrate* crystallises in yellow prisms melting when suddenly heated at 202—203°, but decomposing at 193—195° when maintained at this temperature for some time.

2 : 4-*Tetramethyldiaminotoluene* is a pale brownish-yellow oil boiling at 254—256° under 757 mm., and at 148—150° under 24—26 mm. pressure; its sp. gr. is 0·9661 at 24°; its *platinichloride* is decomposed by hot water; the *picrate* crystallises from alcohol in yellow prisms melting at 162—163°. The *methobromide*, $NMe_2 \cdot C_6H_3(CH_3)NMe_3 \cdot Br$, produced together with the tertiary diamine in the methylation of *m*-tolylenediamine, yields a *platinichloride*,

$$NMe_2 \cdot C_6H_3(CH_3)NMe_3,HPtCl_6,$$

crystallising in brownish-yellow scales.

p-*Nitrobenzene*-5-*azo*-2 : 4-*tetramethyldiaminotoluene*, resulting from the action of *p*-nitrobenzenediazonium chloride on 2 : 4-tetramethyldiaminotoluene, crystallises from alcohol or ethyl acetate in dark green leaflets with a bronze reflex and melts at 126—127°.

2 : 4 : 2′ : 4′-*Octamethyltetraminoditolyl*-5 : 5′-*methane*, prepared by con-

densing 2 : 4-tetramethyldiaminotoluene with formaldehyde, crystallises from alcohol in colourless prisms melting at 86° ; its *picrate* separates in spherical aggregates of yellow crystals and melts at 147—148°.

60. "The influence of certain acidic oxides on the specific rotations of lactic acid and potassium lactate." By G. G. Henderson and D. Prentice, Ph.D.

The authors have examined the influence of antimonious, arsenious, and boric oxides on the rotations of aqueous solutions of potassium lactate and lactic acid, with the object of ascertaining whether any compounds of the tartar emetic type are formed in solution by interaction of these substances.

It was found that antimonious oxide is almost insoluble in solutions of potassium lactate, and that the rotations of the solutions are not appreciably affected by the presence of traces of antimonious oxide. Arsenious oxide and boric acid, on the other hand, were found to dissolve readily in aqueous solutions of potassium lactate and lactic acid. The rotations of the solutions are altered by the presence of the dissolved oxide, and in each case the maximum change occurs when the substances are present in the proportions requisite for the formation of an arseniolactate, $(AsO)C_3H_4O_3K$, and a borolactate, $(BO)C_3H_4O_3K$, respectively. The rotation of a solution of lactic acid is slightly diminished when arsenious oxide is dissolved in it, but considerably increased by the presence of boric acid.

Experiments with molybdic and other oxides are in progress.

61. "The amounts of nitrogen as ammonia and as nitric acid, and of chlorine in the rain-water collected at Rothamsted. A report to the Lawes Trust Committee." By N. H. J. Miller.

Results of monthly determinations of nitrogen as ammonia and as nitrates in the rain-water collected during thirteen harvest years (September 1888 to August 1901) at Rothamsted, showed that the total nitrogen in these forms varied from 3·31 lbs. to 4·43 lbs. per acre per annum. The average amounts for the winter and summer months, and for the whole year, are as follows :

		Nitrogen per million		Nitrogen per acre (lbs.)		
	Rainfall (inches).	as ammonia.	as nitrates.	as ammonia.	as nitrates.	Total.
Winter ……	14·32	0·381	0.175	1·233	0·568	1·801
Summer ……	12·93	0·506	0·191	1·479	0·560	2·039
Year … …..	27·25	0·440	0·183	2·712	1·128	3·840

Of the total nitrogen 70 per cent. is present as ammonia and 30 per cent. as nitrates. During the summer months there is an increased production of ammonia, whilst the amount of nitric nitrogen (per acre) is nearly the same in summer as in winter.

Chlorine has been determined monthly for twenty-four years. The average amounts are as follows :

September 1877 to August 1901.	Rainfall (inches).	Chlorine per million.	Chlorine per acre (lbs.)
Winter months............	14·65	3·05	10·12
Summer months	14·13	1·49	4·75
Year	28·78	2·28	14·87

The yearly amounts of chlorine in the rain vary considerably (maximum 21·19, minimum 10·32 lbs. per acre). The variations depend less on the total rainfall for the year than on the amount of rain during the winter months.

The rain falling at Rothamsted supplies, not only sufficient chlorine, but also enough sulphuric acid for the requirements of most crops.

62. "The amounts of nitrogen, as nitrates, and chlorine in the drainage through uncropped and unmanured land. A report to the Lawes Trust Committee." By N. H. J. Miller

The percolation through the 20, 40, and 60 inches of soil in the three Barnfield drain gauges amounted during 24 harvest years, Sept. 1877 to Aug. 1901, to 14·39, 15·30, and 14·41 inches per annum, being 50·0, 53·2, and 50·1 per cent. respectively of the rainfall for the same period. The maximum and minimum drainage occur in November and June.

The average loss of nitrogen, as nitrates, in the drainage is more than 30 lbs. per acre per annum, and about half of this loss takes place during October, November, and December. The yearly losses of nitrogen differ widely, according to the amount and distribution of the rain and drainage. This makes it difficult to form a decided opinion as to whether nitrification is less active at the present time than in earlier years. A very decided falling off is perhaps not to be expected in the near future. The soil of the 20-inch gauge is estimated to have contained, in 1870, as much as 6000 lbs. of nitrogen per acre, and of this amount only about 15 per cent. has been found in the drainage; in the case of the 60-inch gauge, the estimated loss is only 6·5 per cent. of the total initial nitrogen of the soil. In addition to loss of nitrogen, there is, however, a considerable loss of lime, amounting to 11 lbs. per acre (or about 20 lbs. of calcium carbonate) per inch of drainage, and this loss may, as time goes on, be expected to influence the changes in the organic matter of the soils.

The average yearly amounts of chlorine per acre in the drainage is very similar to the amount found in the rain, but wide differences occur in some individual years. In the 24 years during which the chlorine has been determined, the soils of the 20-inch and 40-inch gauges have received from the rain 7·0 and 14·4 lbs. of chlorine per acre in excess of the amounts lost in drainage. The 40-inch gauge has lost 17·5 lbs. of chlorine.

63. "Benzylidenecamphoroxime." By M. O. Forster.

An examination of α-aminocamphoroxime, described by Lapworth and Harvey (this vol., p. 70), appears to have been undertaken with the object of investigating changes which substituted camphoroximes undergo in virtue of the presence of the oximido-group. This has been the author's aim in his study of camphoroxime, which has extended over several years, and contributions to the chemistry of β-chlorocamphoroxime, β-bromocamphoroxime, and α-benzylidenecamphoroxime have been already made. As Lapworth and Harvey have notified privately their intention to abandon the investigation, the author wishes to intimate that he proposes to continue the study of substituted camphoroximes. The following observations relating to benzylidenecamphoroxime are now put on record.

Benzylidenecamphoroxime, $C_{17}H_{21}ON$, dissolves sparingly in boiling alcohol, and crystallises in transparent hexagonal prisms, melting at 197°; for a 2 per cent. solution in chloroform, $[\alpha]_D = +389°$. The *benzoyl* derivative crystallises from petroleum in lustrous, well-formed prisms, and melts at 106—107°; for a 2 per cent. solution in chloroform, $[\alpha]_D = +246°$. The *phenylcarbamate* separates from alcohol in tufts of long, silky needles, and melts at 169°, when it evolves gas; a 2 per cent. solution in chloroform has $[\alpha]_D = +275°$. Nitrous acid converts benzylidenecamphoroxime into the *compound*, $C_{17}H_{20}O_2N_2$, which melts at 117°, and gives Liebermann's reaction.

Attempts to convert the oxime into benzylidenecampholenonitrile by the agency of boiling sulphuric acid (25 per cent.) have been un successful, but acetyl chloride gives gise to a *nitrile* which is unsaturated, and feebly lævorotatory.

The oxime is indifferent towards sodium amalgam, which reduces benzylidenecamphor to benzylcamphor, but sodium in boiling amyl alcohol reduces it to bases which probably represent the α-benzyl derivatives of bornylamine and neobornylamine; the *platinichloride* from the dextrorotatory hydrochloride melts at 235°, whilst the *platinichloride* from the lævorotatory hydrochloride melts at 247°.

ADDITIONS TO THE LIBRARY.

I. *By Donation.*

Simmance, John F. Calorimetry of producer and illuminating gases, with special reference to future legislation. Pp. 30. London 1902. From the Author

II. *By Purchase.*

Daniel, J. Dictionnaire des matières explosives. Préface de M. Berthelot. Pp. 815. Paris 1902.

Landolt, Hans Heinrich. Das optische Drehungsvermögen organischer Substanzen und dessen praktische Anwendungen. Zweite gänzlich umgearbeitete Auflage. Pp. 655. Braunschweig 1898.

At the next meeting, on **Wednesday, April 30th**, at **5.30 p.m.**, there will be a ballot for the election of Fellows and the following papers will be communicated :—

"On the preparation of absolute alcohol from strong spirit." By S. Young.

"On the properties of mixtures of the lower alcohols with water." By S. Young and E. C. Fortey.

"On the properties of mixtures of the lower alcohols with benzene, and with benzene and water." By S. Young and E. C. Fortey.

"Fractional distillation as a method of quantitative analysis." By S. Young and E. C. Fortey.

"On the vapour pressures and boiling points of mixed liquids. Part I." By S. Young.

"The correction of the boiling points of liquids from observed to normal pressure." By S. Young.

"Vapour pressures and specific volumes of *iso*propyl *iso*butyrate." By S. Young and E. C. Fortey.

"Nitrogen bromides containing the propionyl group." By F. D. Chattaway.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, April 30th, 1902.

Ashe, James Samuel,

The Adelaide Hospital, Dublin.

Professor and Lecturer on Materia Medica Pharmaceutical Society, Ireland. Licentiate (1st place) and Member Pharmaceutical Society, Ireland. Late Assistant and Demonstrater Materia Medica, R.C.S.I. 1st place Honoursman Chemistry, Physics, &c., Royal College Physicians and Surgeons, Ireland. Studied Chemistry under Professor Reynolds at Dublin University.

J. Emerson Reynolds.
E. S. Cameron.
Chas. R. C. Tichborne.
John Attfield.
Thomas Tyrer.
Emil A. Werner.

Baker, Frederic Guy Stirling,

Marryatts Lodge, Snaresbrook, Essex.

Student. Studied Chemistry for four years at Oxford University, Third Class Honours in Natural Science School. At present studying Applied Chemistry in the Laboratory of Mr. Chapman.

Alfred C. Chapman.
V. H. Veley.
W. W. Fisher.
John Watts.
J. E. Marsh.

Bergtheil, Cyril,

"Checkley," Redhill, Surrey (probably removing shortly to India).

Bacteriologist. Six months at Industrie Schule, Nürnberg. Two years at University College, London. One year at South-Eastern Agric. Coll., Wye. Bacteriologist to Bihar Planters' Assoc.

William Ramsay.
A. D. Hall.
Horace T. Brown.
Morris W. Travers.
F. G. Donnan.

Boardman, Ernest, B.Sc.,

41, Knowsley Road, Smithills, Bolton.

Science Master, Central School, Bolton. Student for three years in the Owens College Laboratories. B.Sc. Vict., 1896. Five years' Science Teaching.

Harold B. Dixon. G. H. Bailey.
W. H. Perkin, jun. Norman Smith.
William A. Bone.

Blenkinsop, Richard,

Garden Wharf, Battersea.

Manufacturing Chemist. Two years at the Central Technical College under Prof. Armstrong. At present in the employ of Messrs. May and Baker, Ltd., of the above address.

Henry E. Armstrong. W. N. Hartley.
Gerald T. Moody. *David Howard.*
William A. Davis. *George Beilby.*

Bruce, Alexander,

10, Portland Terrace, Plumstead, S.E.

Chemist. Four years Assistant to Prof. Aitken, Royal (Dick) Vet. College, Edinburgh. Three years Edin. University, graduated B.Sc. 1900. Honours in Chemistry. One year Assistant Chemist Explosives Committee, Royal Arsenal, Woolwich.

Alex. Crum Brown. Hugh Marshall.
Leonard Dobbie. O. Silberrad.
William H. Sodeau.

Carrodus, Fred,

Glen Fern Tower, Lansdowne Road, Wimbledon, S.W.

Senior Science Master, King's College School, Wimbledon Common, S.W. Associate in Chemistry, Royal College of Science, 1887. Assistant Demonstrator in Physics, R.C.S., London. Assistant Lecturer in Physics, Yorkshire College, 1891—5. Extension Lecturer in Photography, Leeds, 1891—5. Senior Science Master, King's College School, Wimbledon Common, S.W., 1895—1902. House Master, King's College School, 1900—2.

John M. Thomson. Patrick H. Kirkaldy.
Herbert Jackson. Chapman Jones.
G. S. Newth.

Clowes, George Henry Alexander, Ph.D. Göttingen,

Gratwick Research Laboratory for Cancer, Buffalo, U.S.A.

Research Chemist. Student in Chemistry at Royal College of

Science, 1894—97 ; University of Göttingen, 1897—99 ; and Pasteur Institute, 1899—1900.

William A. Tilden. M. O. Forster.
W. Palmer Wynne. G. T. Morgan.
H. Burrows.

Cook, Arthur James,
167, Richmond Road, Hackney, N.E.

Appointed Assistant Chemist to the Associated Portland Cement Manufacturers, Limited. I have successfully taken the Diploma Course in Chemistry at the Central Technical College, 1898—1901.

Henry E. Armstrong. Gerald T. Moody.
T. M. Lowry. William A. Davis.
James Moir.

Crocker, James Codrington,
2, Flynone Villas, Swansea.

Junior Demonstrator, University Lab. ; engaged in Research. 1st Class Nat. Science Tripos ; Part I. 1900, 1st Class Nat. Science Tripos ; Part II., 1901 (Chemistry). Scholar of St. John's College. B.A. (Cantab.)

G. D. Liveing. W. J. Sell.
H. J. H. Fenton. H. O. Jones.
W. H. Mills.

Crookes, Henry,
109, Ladbroke Grove, London, W.

Analytical and Metallurgical Chemist. Associate of the Royal School of Mines, Chief Assistant at the London Water Company's Laboratory for nine years, am still there. Was one year an assistant at "Cocquerel's Chemical Manure Factory" near Paris ; also studied Chemistry at the "Ecóle de Médicine" at Paris, under the late Prof. Würtz.

William Crookes. James Dewar.
Henry E. Armstrong. T. E. Thorpe.
J. H. Gladstone. W. J. Russell.
David A. Louis.

Davis, Charles Benson,
218, W. 134th St., New York City, U.S.A.

Analytical and Technical Chemist. Specialist in Brewing and Bacteriology. With Dr. Durand Woodman, 80, Beaver St., N.Y., three years, as Analytical Chemist. For the past five years, and at present, Analytical Chemist to the National Brewers' Academy (Dr.

Wyatt). Papers published: 1. Water in Oils, Fats, and Waxes (*J.* [*Amer.*] *Chem. Soc.*, July, 1901). 2. New Alkalimeter, and Method for Carbonic Acid Estimation (January, 1902).

John S. Adriance.	John A. Mathews.
J. H. Wainwright.	*Peter T. Austen.*

W. D. Crumbie.

Everitt, Walter,

83, The Grove, Ealing, W.

Chemical Assistant at the Government Laboratory (Customs Branch). Formerly Assistant to Edward Riley, Esq.

T. E. Thorpe.	James Connah.
Otto Hehner.	W. Williamson.
Bernard Dyer.	Edw. Riley.

Gill, J. Arthur,

19, Burma Road, Stoke Newington, N.

Analytical and Research Chemist to Messrs. A. Boake, Roberts & Co., Chemical Manufacturers, Stratford, E. Three years' chemical course at The Owens College, Manchester. Microbiology under Professor Delépine, Owens College; and Alfred Jórgensen in Copenhagen. A year of commercial analysis in the Manchester Chamber of Commerce Testing House.

B. E. R. Newlands.	H. B. Dixon.
F. G. Adair Roberts.	W. H. Perkin, jun.

J. F. Thorpe.

Griffiths, John T.,

Grammar School, Hanley Castle, Worcester.

Science Master. Science Master for one year at Grammar School, Pincader, Wales. Science Master for two years at Hanley Castle Grammar School, Worcester. Have taken Int. B.Sc. (Lond.), 1898. Received my training at Univ. Coll., Aberystwyth, and Royal College of Science, London.

H. Lloyd Snape.	W. Palmer Wynne.
William A. Tilden.	M. O. Forster.

Cecil Cooke Duncan.

Gunn, Gilbert,

209, Rochdale Road, Bury, Lancashire.

Technical Chemist in Paper Mill, thirteen and a half years. Obtained Honorary Certificate for distinguished excellence in Theoretical and Experimental Chemistry, Glasgow Royal Infirmary School of Medicine, 1883–1884. Demonstrator two Sessions, 1884–1885, 1885–1886.

Head Assistant to Professor Milne, Ph.D., F.I.C., 1887. Have investigated the Microchemical Reactions of the Celluloses.

Herbert W. Hart.
A. Humboldt Sexton.
Jul. Hübner.
C. F. Cross.
G. G. Henderson.

Hopwood, Arthur,

49, Stanley Street, Tunstall.

Science Master. Consulting and Analytical Chemist, Associate of the Royal College of Science, London. City and Guilds First Class Honours, Medallist and Prizeman in Chem. Tech. Board of Education Double Honoursman in Org. and Inorg. Chemistry. Headmaster and Lecturer on Chemistry at the School of Science, Tunstall.

George George.
William Carter.
Chapman Jones.
Albert Taylor.
Gerald G. Quinn.

King, Frank Eustace,

Woodbury, Polworth Road, Streatham, S.W.

Assistant Analyst. Educated at Dulwich College. Four years on Science Side; 2 years Student at University College, London Bachelor of Science of London University (First Class Hons. Chemistry); now (and for 3 years) Assistant to Dr. Bernard Dyer.

H. Brereton Baker.
William Ramsay
Bernard Dyer.
Otto Hehner.
Alfred C. Chapman.

King, Sidney Isaac,

49, Arundel Square, London, N.

Analytical Chemist. Student for 4 years in Chemistry and Dyeing at Bradford Technical College under Dr. Knecht and Christopher Rawson, Esq. Have also studied Chemistry and Dyeing at Herold's Institute, S.E. Am at present Technical Chemist to Messrs. Wickens Pease & Co., Ltd., Oil and Tallow Refiners, Soap Manufacturers, &c.

C. Rawson.
F. Napier Sutton.
M. Chas. Lamb.
Samuel Rideal.
J. Lewkowitsch.
Arthur R. Ling.

Kewley, James,

King's College, Cambridge.

Junior Demonstrator, University Laboratory. First Class, Part I Natural Science Tripos, 1901. Major Scholar King's College B.A.

G. D. Liveing.
H. J. H. Fenton.
W. H. Mills.
W. J. Sell.
F. W. Dootson.
H. O. Jones.
C. T. Heycock.

Landau, A. Lionel,

20, Highbury New Park, N.

Starting practice as Analytical and Consulting Chemist. Certificated Chemist of Finsbury Technical College.

Raphael Meldola F. Southerden.
J. V. Eyre. E. H. Miller.
Alfred C. Chapman.

Lockitt, Charles Henry, B.A. (Lond.),

5, Harley Road, S. Hampstead, London, N.W.

Assistant Master in a Secondary School. Have passed Intermediate Science Exam., Lond. Univ. (1st Division). Have for some time been working at B.Sc. Chemistry. Have taught a little chemistry in a Grammar School. Am desirous of following modern developments in the subject.

J. Herbert Allworthy. Alexander W. Bain.
J. W. Shepherd. Fred. Bedford.
Fredk. A. Drake.

Mathieson, Robert, J.P.,

Rillbank, Innerleithen, Peebleshire.

Chemist, Druggist, and Manufacturing Chemist. Formerly Student of Analytical and Physical Chemistry at Gordon's College, Aberdeen, and University of Edinburgh. Desire to keep informed as to the latest developments in Chemical Science, and to obtain a knowledge of the most recent analytical processes.

Stevenson Macadam. *William Duncan.*
Adam Gibson. *Wm. Hall Jowett.*
Robt. Carruthers. *J. W. Clayton.*

Mence, George Augustus Henry, B.Sc., Lond.,

Ouse Villa, St. Ives, Hunts.

Teacher of Chemistry and Physics. Science Master at the Border School. Sometime a Student at the Technical College, Finsbury.

Gerald T. Moody. William A. Davis.
Richard Berncastle. *George Harker.*
Edward W. Lewis.

Macknight, Alexander,

Brucefield, Whitburn, N.B.

Analytical Chemist and Assayer. At present Chemist to the paper mills at Rishton and Whiteash, Lancashire. Three years as Student-Assistant to the late Dr. Macadam, Edinburgh, during which time classes were taken at Edinburgh University. One year attending classes on Metallurgy, Assaying, &c., at the Glasgow Technical College. Since then having acted as Assistant to Dr. Aitken, Edinburgh, until present appointment was obtained. Recently elected as a member of the Edinburgh Geological Society.

Stevenson Macadam.
W. Ivison Macadam.
A. Humboldt Sexton.
George Smith.
G. G. Henderson.

Martindale, William Harrison,

10, New Cavendish Street, London, W.

Analytical and Pharmaceutical Chemist. Ph.D. Marburg. Holding the Major Certificate of the Pharmaceutical Society of Great Britain.

Thomas Tyrer.
Thos. Stevenson.
Otto Hehner.
David Howard.
D. Lloyd Howard.

Peck, John Wicliffe,

28, West Elba Road, Harlesden, N.W.

Pharmaceutist to the Hospital for Sick Children, Great Ormond Street, W.C., and Bacteriological Assistant to the Hospital. Pharmaceutical Chemist and Student of Analytical and Bacteriological Chemistry. I desire to be more fully in touch with the highest developments of chemical knowledge.

J. A. Dewhurst.
Edwd. Brooke.
Reginald G. Halstead.
Theophilus Pitt.
R. F. Wood Smith.
R. L. Jenks.
Wyndham R. Dunstan.

Ramshaw, Walter,

5, Fronwen Terrace, Brecon.

Science Teacher. Teacher of Chemistry, County School, Brecon. Three years Student in Chemical Department of the Yorkshire College, Leeds.

Arthur Smithells.
J. B. Cohen.
J. McCrae.
Herbert Ingle.
H. D. Dakin.

Revis, Cecil,

77, King Street West, Hammersmith, W.

Chief Analyst to Messrs. Welford & Sons, Ltd., Maida Vale, W. The following papers have been published: "New Derivatives of *a*-Hydrindone" (*P. Chem. Soc.*, 1895, 214); New Derivatives of *a*-Hydrindone" (*Trans. Chem. Soc.*, 1897, 71, 239); "*a*-Bromocamphorsulpholactone" (*P. Chem. Soc.*, 1896, 247); "*π*-Bromocamphor, Derivatives of" (*P. Chem. Soc.*, 1896, 77). [In conjunction with Dr. F. S. Kipping.] "A Polarimetric Method of Estimating Tannin" (*Analyst*, 23, No. 263) [with Mr. R. F. Wood-Smith]; "A New Method of Examining Milk for various Bacteria" (*J. Path. Bact.*, June, 1901).

Henry E. Armstrong. Gerald T. Moody.
Alf. W. Stokes. William A. Davis.
T. Martin Lowry.

Roberts, Jonathan Hugh,

Oban Gwys, Swansea.

Science Lecturer. Graduate in Chemistry, Oxford University. Senior Science Master, Ripon School.

W. W. Fisher. J. E. Marsh.
V. H. Veley. P. Elford.
John Watts.

Scholes, William,

151, Ainsworth Road, Radcliffe, Lancs.

Science Teacher. Associate, Royal College of Science, Lond. (1st Class Chem.). First Class Honours, Pract. S. and. A. Exam., 1896. Chemistry Teacher, Ramsbottom Technical School.

William A. Tilden. G. T. Morgan.
W. Palmer Wynne. R. L. Taylor.
M. O. Forster. J. H. Wolfenden.

Taylor, Thomas,

12, Ancaster Drive, Great Western Road.

Chemical Manufacturer. I have studied at the Glasgow and West of Scotland Technical College for four years, and took the diploma in Chemistry. Appointed Lecture Assistant to Professor Henderson, 1899—1900. Lecture Assistant to Professor Purdie, St. Andrews, 1900—1901. Associate of the Institute of Chemistry.

G. G. Henderson. James Robson.
Thomas Purdie. Matthew A. Parker.
Thomas Gray.

Tindall, Arthur Lea Butler,

41, Sunnyside Rd., Ilford.

Schoolmaster. B.A. Science Honours, Camb. 1890, M.A. 1896. Teaching Chemistry.

Frank Dixon. W. H. C. Jemmet.
Stuart Blofeld. *A. Hyder.*
P. H. Grant.

Trimen, Stephen Herbert,
61, St. John's Park, London, N.

Assistant Chemist in the Customs House Branch of the Government Laboratory. I was educated at Highgate School and left there to study Chemistry under Prof. Meldola, F.R.S., at the City and Guilds Technical College, Finsbury. I was there four years, during the last of which I acted as Senior Student or Junior Demonstrator in the Chemical Dept., after gaining the Certificate of the College. I left there in 1900 to take up a temporary appointment in the Laboratory of the London County Council under Prof. F. Clowes, D.Sc. When that terminated, I obtained the post as Assistant Chemist in the Manbré Saccharine Co.'s Works at Hammersmith, and left there at the end of October, 1901, since when I have been in my present position, as above.

Raphael Meldola. Frank Clowes.
T. E. Thorpe. James Connah.
W. Williamson.

Tunnicliffe, William Wright,
Newhall, Burton-on-Trent.

Headmaster of the Central Board School, Newhall, Burton-on-Trent (No. of scholars in average attendance, 650). 1. Trained Certificated Teacher of the First Class. 2. Passed London University Intermediate Science Examination. 3. Obtained Honours in Practical and Theoretical Chemistry at the Science and Art Department's Examinations. 4. Pupil of Dr. Chas. F. Baker, late of the Birmingham University. 5. Taught Chemistry to large classes in preparation for the Examinations of the Science and Art Department for the last seven years.

William A. Tilden. C. F. Baker.
M. O. Forster. *Chapman Jones.*
G. T. Morgan. *James C. Philip.*

Wain, William Charles,
Sydney, New South Wales.

Mercantile Explosive Department. Late Chief Assistant Government Analyst, Queensland. Now Chief Chemist and Inspector of Explosives for New South Wales.

Harold Harris. Alexander Orr.
John C. H. Mingaye. *W. M. Doherty.*
B. H. Bennetts.

Wilkinson, Edward John,
8, Blenheim Terrace, Leeds.

Lecturer in Dyeing, University College of Wales, Aberystwyth.

Three years a Student in the Chemical and Dyeing Departments of the Yorkshire College. For one year Assistant in the Dyeing Department, Yorkshire College. Joint author with Mr. A. G. Perkin of *Proc. Chem. Soc.*, 16, No. 142, 182.

J. J. Hummel.
Arthur Smithells.
Julius B. Cohen.
Andrew Turnbull.
Henry R. Procter.
A. G. Perkin.
H. M. Dawson.
Herbert Ingle.

Wood, Frank Stanley,

25, Suffolk St., Newland, Hull, Yorkshire.

Cement Works Chemist. Student Royal College of Science, 1889—1890. 1890—1894 in charge of Chemical Laboratory of the late Henry Farja, M.I.C.E. Portland Cement research work and analysis. 1894—1897 similar work for his successor, D. B. Butler, F.C.S. 1897—1902. Chief Chemist, with five subordinates, at the Cement Works of Messrs. G. and T. Earle, Limited, Hull.

D. B. Butler.
E. G. Clayton.
Fred. E. Johnson.
George F. Holloway.
Jas. Baynes.
Harold M. Ready.
Bertram Blount.
G. Carr Robinson.

Young, Thos. A,

318, Cheetham Hill Road, Manchester.

Manufacturing and Consulting Chemist, &c. Five years student in the laboratory of Dr. Burghardt, Manchester. Student, Owens College. Specialist in Colour Manufacture, &c. Director, 'Ircena' Colour Company.

Walter Ratcliffe.
Arthur E. Thornton.
George J. Allen.
Charles A. Fogg.
T. M. Nightingale.

The following Certificate is authorised by Council under Bye-Law I. (3).

Dobson, Henry Arthur,

"Cairne Regis," Peisley St., Orange, N.S.W.

Analytical Chemist. Late Manager, Lyndhurst Gold Fields, Ltd., Mandurama, N.S.W. Cyanide Chemist, Burdett G. M., Ltd., Near Orange, N.S.W. Studied Chemistry in the Cambridge University Chem. Lab., and also in the Auckland University Chem. Lab. (N.Z.).

Thomas H. Easterfield.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 251.

Wednesday, April 30th, 1902. Professor EMERSON REYNOLDS, Sc.D., V.P.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs:

Ferris, Percy J., Heathfield, Seymour Grove, Old Trafford, Manchester.
Gow, Alexander, 38, Clarendon Street, Cambridge.
Hann, Archie Cecil Osborn, 54, Wood Vale, Forest Hill, S.E.
Harrison, Walter Ernest, 43, Mostyn Road, Handsworth, Staffs.
O'Connor, Sinnott Valentine, 14, Selskar Street, Wexford.
Ralph, Stephen Jamieson, 22, Stanley Place, Eccleston Square, S.W.
Ralphs, Edwin, Hong-Kong.

A Ballot for the Election of Fellows was held, and the following were declared duly elected:—

James Samuel Ashe.
Frederic Guy S. Baker, B.A.
Cyril Bergtheil.
Richard Blenkinsop.
Ernest Boardman, B.Sc.
Alexander Bruce, B.Sc.
Fred. Carrodus.
G. H. A. Clowes, Ph.D.
Arthur James Cook.
James Codrington Crocker, B.A.
Henry Crookes.
Charles Benson Davis.
Henry Arthur Dobson.
Walter Everitt.
J. Arthur Gill.
John T. Griffiths.
Gilbert Gunn.
Arthur Hopwood.
Frank Eustace King, B.Sc.
Sidney Isaac King.
James Kewley, B.A.
A. Lionel Landau.
C. H. Lockitt, B.A.
Alexander Macknight.
William H. Martindale, Ph.D.
Robert Mathieson.
George A. H. Mence, B.Sc.
John Wicliffe Peck.
Walter Ramshaw.
Cecil Revis.
Jonathan Hugh Roberts, B.A.
William Scholes.
Thomas Taylor.
Arthur Lea B. Tindall, M.A.
Stephen Herbert Trimen.
William Wright Tunnicliffe.
William Charles Wain.
Edward John Wilkinson.
Frank Stanley Wood.
Thos. A. Young.

Of the following papers those marked * were read :—

*64. "The preparation of absolute alcohol from strong spirit."
By S. Young, D.Sc., F.R.S.

The strongest spirit that can be obtained by distillation with the most perfect still-head contains less than 96 per cent. by weight of pure alcohol. In order to remove the remainder of the water, dehydrating agents have always been employed, but they do not give very satisfactory results; according to Mendeléeff, freshly ignited lime is the only one by means of which pure dry alcohol can be prepared, and, even with this substance, special precautions have to be taken to ensure success. More recently, Squibb has obtained alcohol of still lower specific gravity by the long continued action of lime in a percolator, but his results, unlike those of Mendeléeff, were somewhat variable.

The method of dehydration recommended by the author depends on the fact that when a mixture of alcohol, benzene, and water is distilled, separation tends to take place into (1) a ternary mixture of alcohol, benzene, and water boiling constantly at 64·85°; (2) one of three possible mixtures of constant boiling point, (*a*) alcohol-benzene, b. p. 68·25°; (*b*) benzene-water, b. p. 69·25°; (*c*) alcohol-water, b. p. 78·15°; (3) one of the three pure substances, alcohol, b. p. 78·3°; benzene, b. p. 80·2°; water, b. p. 100°.

For example, when a mixture of equal weights of 93 per cent. alcohol and benzene is distilled, the fractions are (1) the ternary mixture containing, theoretically, the whole of the water; (2) the binary alcohol-benzene mixture; (3) pure alcohol.

Pure benzene and dilute alcohol are easily recovered from the ternary and binary mixtures, and there is practically no loss of material.

Theoretically, a single distillation should be sufficient to remove the whole of the water, but the separation is a difficult one, and even with a very efficient still-head a second, or even third, distillation with more benzene is necessary; the water may thus be completely eliminated, but there appears to be a trace of benzene left in the alcohol. This trace of benzene may be completely removed by distillation of the dehydrated alcohol with *n*-hexane; the binary hexane-alcohol mixture which comes over first carries the benzene with it and no hexane is left in the residual alcohol.

The observed specific gravities of dehydrated alcohol are as follows:

Mendeléeff, by means of lime	0·80625 at 0°/4°
Young, by means of benzene	0·80634 „
„ „ benzene and hexane..	0·80627 „

*65. "On the properties of mixtures of the lower alcohols with water." By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.

Methyl alcohol does not form a mixture of minimum boiling point with water, and, contrary to general opinion, dry methyl alcohol can be easily obtained by distillation of the dilute alcohol with an efficient still-head. The alcohol so obtained is drier than when the strongest dehydrating agents are used.

As regards the purification of the other six alcohols investigated, distillation with benzene gave the best results with ethyl, *iso*propyl, *n*-propyl, and tertiary butyl alcohols; this treatment was also found useful in the case of *iso*butyl and *iso*amyl alcohols for the removal of lower homologues. All these alcohols were found to form mixtures of minimum boiling point with water. The boiling points and the composition of these mixtures of constant boiling point were determined, also the contraction which occurs on mixing the alcohols with water in various proportions, and the approximate temperature changes for certain mixtures. It was found that (*a*) the differences in boiling point between the alcohol and the alcohol-water mixtures of constant boiling point, (*b*) the molecular percentages of water in these mixtures, follow the same order as the boiling points of the alcohols themselves. So far as experiments have been made, the heat evolution diminishes or the heat absorption increases as the boiling points of the alcohols rise.

As regards the primary alcohols, the percentage contractions on mixing with water diminish as the boiling points of the alcohols rise, but irregularities were observed with the secondary and the tertiary alcohols investigated.

The experiments show that as the molecular weights of the alcohols increase, the attractions of their molecules for those of water diminish, but the constitution as well as the composition of the alcohols must be taken into account. The constant boiling point mixtures which the alcohols form with water are in no case hydrates of the alcohols.

*66. "On the properties of mixtures of the lower alcohols with benzene and with benzene and water." By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.

Of the seven alcohols examined, all except *iso*amyl alcohol form mixtures of constant boiling point with benzene. The boiling points of these mixtures and the molecular percentages of benzene in them follow the same order as the boiling points of the pure alcohols. The boiling point of the *iso*butyl alcohol-benzene mixture is very near that of benzene itself; neither *iso*amyl alcohol nor any other alcohol with a higher boiling point can form a mixture of constant boiling point with benzene.

Of these alcohols, only ethyl, *iso*propyl, *n*-propyl, and tertiary butyl alcohols form ternary mixtures of constant boiling point with benzene and water. When a mixture of methyl alcohol, benzene, and water is distilled, the first fraction consists of the binary alcohol-benzene mixture, and when a mixture of either *iso*butyl or *iso*amyl alcohol with benzene and water is distilled, the first fraction consists of the binary benzene-water mixture. No alcohol of this series with a boiling point higher than that of *iso*butyl alcohol can form a ternary alcohol-benzene-water mixture of minimum boiling point; with these higher alcohols, the first fraction will always consist of the binary benzene-water mixture.

The boiling points and the composition of the binary alcohol-benzene and the ternary alcohol-benzene-water mixtures have been determined.

*67. "Fractional distillation as a method of quantitative analysis." By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.

It has already been pointed out (Young, *J. Soc. Chem. Ind.*, 1900, **19**, 1072) that the composition of a mixture of two homologous substances can be ascertained with a fair degree of accuracy from the results of one or more fractional distillations with a very efficient still-head without bringing about anything like a complete separation of the components.

The method has now been found applicable, not only to mixtures which separate normally into their original components, whether homologous or not, but also to cases in which binary or ternary mixtures of constant boiling point are formed, such mixtures behaving, as regards distillation, like pure substances. It depends on the following facts. In the case of a mixture which tends to separate into two components, the weight of distillate that comes over below the temperature midway between the boiling points of the two components—whether single substances or mixtures of constant boiling point—is almost exactly equal to that of the more volatile component. If the original mixture tends to separate into more than two components, the weight of these components will be very nearly equal to the weight of distillate below the first middle point, the weights of distillates between the successive middle points, and the weight above the last middle point respectively.

When a binary mixture of constant boiling point is formed, the method may be employed for the determination of its composition if that of the original mixture is known, or of the original mixture if that of the binary mixture is known; when the original mixture tends to separate into a ternary mixture, a binary mixture, and a single substance, the composition of the ternary mixture may be ascertained if that of the binary mixture and of the original mixture are known.

There are a few cases such as that of ethyl alcohol and water, or of benzene and *n*-hexane, to which the method is not applicable. In these, the curve representing the relation between boiling point and molecular composition is exceedingly flat where the more volatile component is in large excess. When this is so, the separation by fractional distillation of the more volatile component, whether a single substance or a mixture of constant boiling point, is practically impossible.

*68. "On the vapour pressures and boiling points of mixed liquids."

By S. Young, D.Sc., F.R.S.

The question as to what should be regarded as the normal behaviour, with reference to their vapour pressures and boiling points, of mixtures of two liquids soluble in each other in all proportions, has been discussed by several investigators.

It seemed probable that the simplest possible relations would be observed in the case of two such closely related substances as chlorobenzene and bromobenzene, the critical points of which are the same, whilst the ratio of the boiling points on the absolute scale is constant at all equal pressures. Other simple physical relations exist between these substances, and no perceptible heat change or volume change occurs on mixing them.

The boiling points of several mixtures of chlorobenzene and bromobenzene were determined over a range of about 100 mm., and the results are in accurate accordance with the law which Van der Waals states should hold good for two liquids the critical points of which are equal, and for which $a_{1 \cdot 2} = \sqrt{a_1 . a_2}$ (Galitzine, Berthelot), where $a_{1 \cdot 2}$ represents the mutual attraction of the unlike molecules and a_1 and a_2 the attractions of the like molecules.

The law may be stated thus: The relation between the vapour pressures and the molecular composition of mixtures of such substances is represented by a straight line: or $P = \frac{p.P_A + (100 - p)P_B}{100}$, where P, P_A, and P_B are the vapour pressures of the mixture and of the two pure components, A and B, at the same temperature, and p is the molecular percentage of one of them.

*69. "The correction of the boiling points of liquids from observed to normal pressure." By S. Young, D.Sc., F.R.S.

Crafts (*Ber.*, 1887, **20**, 709) gave a convenient table for the correction of the boiling points of liquids from observed to normal pressure. There are, however, a few misprints in the table, and since then accurate determinations of the vapour pressures of a large number of pure substances have been made; it therefore seems desirable to give a revised and enlarged table for reference.

Crafts gave mean values of $\frac{\Delta t}{\Delta p}.\frac{1}{T}$ for pressures between 720 and 770 mm., but it seems more convenient, on the whole, to give the values of $\frac{dt}{dp}.\frac{1}{T}=C$ at 760 mm.

Various relations exist between the values of C and the chemical composition and constitution of the substances considered, and there is clearly a connection between the variations in the values of C and of other constants which have been considered in previous papers, such as $\frac{Dc}{D'c}$, the ratio of the actual to the theoretical density at the critical point.

*70. "Vapour pressures and specific volumes of *iso*propyl *iso*butyrate." By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.

By the electrolysis of potassium *iso*butyrate, the yield of di*iso*propyl was found to be very poor, but a fair quantity of *iso*propyl *iso*butyrate was obtained. As this ester contains two *iso*-groups, it was thought that it would be of interest to determine its vapour pressures, specific volumes, and critical constants. For the sake of comparison, a second specimen of the ester was prepared from *iso*propyl alcohol and *iso*butyric acid, and the boiling points and specific gravities of the two specimens were found to agree perfectly.

Unfortunately, *iso*propyl *iso*butyrate is much less stable than any of the ten esters previously examined (Young and Thomas, *Trans.*, 1893, **63**, 1191), for some decomposition takes place at 230° and the rate of decomposition increases rapidly with rise of temperature. It was therefore impossible to make trustworthy determinations of the critical temperature or pressure, so only the vapour pressures and specific volumes at and below 230° are given.

DISCUSSION.

Professor THORPE said, in reference to the observations which had been made by the author concerning the properties of the hydrated alcohols and the thermal disturbance and alteration in volume accompanying the admixture of alcohols with water, that it appeared to be a tradition in the Revenue Service that on mixing ordinary (ethyl) alcohol and water, the combination, or association, of water and alcohol was only completed after a certain lapse of time, or, in other words, the mixture required to stand for some time before it acquired a constant volume, or, what comes to the same thing, a constant relative density. On what experimental evidence this belief was based was unknown to him, and direct observation made under his direction in the Government Laboratory, by Mr. John Holmes, showed that in reality the tradition had no foundation in fact. It probably had its origin in a statement in the original paper by Blagden and Gilpin that the mixtures of alcohol and water employed by them in their classical experiments, when made, were set aside for some months, in order that, as stated by them, the "interpenetration" of the parts should be complete. It seems to have been taken for granted, in fact, that interpenetration, as something apart from complete and uniform miscibility, occurred on admixture, and that this operation required a certain and considerable interval of time.

The observation on the solubility of copper sulphate in methyl alcohol had been frequently made, and he believed some reference was made to it in a paper by the late Mr. Rodger and himself (*Phil. Trans.*, 1894, **185**, 530). According to Forcrand, the bluish compound has the composition $CuSO_4,2CH_3OH$.

Some years ago, he made the observation that a mixture of carbon tetrachloride and methyl alcohol could be obtained which boiled several degrees lower than the boiling point of the more volatile constituent. He had studied the relation between the boiling point and composition of the mixture, determining the composition from the vapour density of the fractions (*Trans.*, 1879, **35**, 544). He would be interested to know how far the quantitative results he had obtained were in conformity with the relations indicated by Dr. Young in the case of other mixtures of miscible liquids.

Mr. PICKERING said that although the existence of a constant-boiling point mixture of two substances cannot be taken as proof that these two substances are combined, yet the fact that the composition is affected to a certain extent by pressure is no proof of the contrary. Aqueous solutions of hydrochloric acid can be distilled unchanged when the composition is approximately $HCl,8H_2O$, and Roscoe and Dittmar were held to have disproved the existence of any such hydrate by showing that the composition is affected by pressure; yet, Berthelot proved that this variability did not by any means negative the existence of a hydrate, the mixture in question being one of comparative, though not of absolute, constancy. Indeed, we could not expect the composition to be unaffected by pressure, unless the compound were perfectly stable, and there were no products of its dissociation present.

The fact, also, that water can be crystallised from a solution does not in any way disprove the existence of a hydrate in solution. The water may be present only as one of the dissociation products of the hydrate, and whether it or the hydrate separates out depends on the circumstances of the crystallisation. Numerous instances in point might be given: thus, water may be crystallised from a 20 per cent. solution of sodium hydroxide, though such a solution will, under other conditions, yield crystals of the heptahydrate, of which it is chiefly composed.

Dr. **Divers** mentioned, in connection with the author's account of the solution of anhydrous copper sulphate, with blue colour, in anhydrous methyl alcohol, that W. Wislicenus and Stoeber had recently pointed out (*Ber.*, 1902, 35, 540) that anhydrous cupric acetate dissolves in methyl alcohol when boiled with it, giving a deep green solution which deposits crystalline cupric methoxide-acetate, $CH_3OCuC_2H_3O_2$, if the boiling be prolonged.

Professor **Young** replied that they had not yet investigated the mixture of carbon tetrachloride and methyl alcohol, but agreed that it would be interesting to determine the composition of the mixture of minimum boiling point by the distillation method, in order to compare the result with that obtained by Professor Thorpe from the vapour density.

He did not regard the variability of the composition of the mixtures of minimum boiling point with the pressure as a sufficient proof, but only as strong confirmatory evidence as to the non-existence of hydrates of the alcohols. The reasons for believing that such hydrates do not exist are fairly numerous, whilst the only ground for assuming that the liquids under consideration are hydrates seems to be that they boil at a constant temperature. Yet the very fact that the boiling points are lower than those of the alcohols themselves or than that of water indicates that the attraction of the unlike molecules is small compared with the attractions of the like molecules, and this could hardly be the case if hydrates were formed. With regard to the interesting action of anhydrous copper acetate on methyl alcohol, he might mention that Beilstein describes a crystalline alcoholate of copper sulphate, $CuSO_4,CH_3OH$.

*71. "The preparation of highly substituted nitroaminobenzenes." By K. J. P. Orton.

The methods at present known of preparing nitroaminobenzenes from anilines are scarcely applicable when the anilines possess two ortho-substituents. The following procedure has been devised, and in most cases gives a quantitative conversion of the aniline into the nitroamine.

To a solution of the aniline (1 part) in glacial acetic acid (25 parts) is added nitric acid (sp. gr. 1·5; 0·75 to 1 part); acetic anhydride (0·75 to 1 part) is slowly added to the cooled mixture. Heat is developed, and the aniline nitrate dissolves, forming a solution of the nitroamine.

By this means, the following nitroamines have been prepared:

1-Nitroamino-3-tribromobenzene and 1-nitroamino-*s*-trichlorobenzene (this vol., p. 58); 1-*nitroamino*-2:6-*dichloro*-4-*bromobenzene,* and 1-*nitroamino*-2:4-*dichloro*-6-*bromobenzene,* $C_6H_2Cl_2Br{\cdot}NHNO_2$, 1-*nitroamino*-2-*chloro*-4:6-*dibromobenzene,* and 1-*nitroamino*-4-*chloro*-2:6-*dibromobenzene,* $C_6H_2ClBr_2{\cdot}NHNO_2$; these four substances crystallise in needles (from water), and all melt and decompose at 136—138°; their *barium* salts crystallise in plates with $1H_2O$. The N-*methyl ether* of nitroamino-*s*-tribromobenzene, $C_6H_2Br_3{\cdot}NMeNO_2$, obtained from the sodium salt and methyl iodide, forms four-sided prisms melting at 95·5°.

1-*Nitroamino*-2:4-*dibromo*-6-*nitrobenzene,* $NO_2{\cdot}C_6H_2Br_2{\cdot}NHNO_2$, m. p. 91—92°, forms yellow plates (from water); 1-*nitroamino*-2:3:4:6-*tetrabromobenzene,* plates melting and decomposing at 136°; 1-*nitroamino*-2:4:6-*tribromo*-3-*nitrobenzene,* yellow, four-sided prisms, melting and decomposing at 108—109°; 1-*nitroamino*-2:4-*dichlorobenzene,* lustrous leaflets from petroleum, melting at 55—56°. The *barium* salt of the last-mentioned substance crystallises in plates with $3\frac{1}{2}H_2O$.

4-*Nitroamino*-3:5-*dibromotoluene,* $CH_3{\cdot}C_6H_2Br_2{\cdot}NHNO_2$, forms slender needles melting and decomposing at 122—123°; 2-*nitroamino*-3:5-*dibromotoluene,* needles, melting at 112° and decomposing at 122°; the *barium* salts from each substance crystallise with $1H_2O$.

When nitroamino-*s*-trisubstituted benzenes contain a bromine atom in the para-position relative to the $\cdot NHNO_2$ group, the nitro-group is capable of displacing the *p*-bromine atom, giving a di-*o*-substituted *p*-nitroaniline. The majority of these nitroamines dissolve in concentrated sulphuric acid, forming a deep purple or violet solution; in the case of nitroamino-2:4-dichlorobenzene, which has an *o*-hydrogen atom, addition of water immediately destroys the purple colour, and a yellow precipitate of 2 : 4-dichloro-6-nitroaniline is formed; in the case of the other nitroamines, in which the hydrogen atoms in positions 2, 4, and 6 are replaced by other atoms or groups, water precipitates from the purple solution a red solid; the latter contains among other substances a di-*o*-substituted *p*-nitroaniline if the original nitroamine had a *p*-bromine atom. The purple solutions in sulphuric acid may possibly correspond to an intermediate stage between the nitroamine and the nitrated aniline.

*72. "The atomic weight of tellurium. Preliminary notice."

By A. Scott.

The many attempts to determine the atomic weight of tellurium which have been published since Mendeléeff published his well-known table of elements indicate very clearly the general recognition that experimental results did not sanction the assignment of a lower atomic weight to tellurium than that of iodine. The problem was rendered more complicated by the variations in the numbers obtained by the same experimenter when he employed different methods in his determinations. This gave rise to the suspicion that the substance purified by the best methods was, or at least might be, a mixture of the true tellurium with a higher homologue. All the most recent researches, and especially those of Pellini (*Ber.*, 1901, **34**, 3807) and of Köthner (*Annalen*, 1901, **319**, 1), seem conclusively to prove, however, that the atomic weight of tellurium is very near 127·64, that of iodine being 126·85. For more than a year the author has been at work on this subject and his results are entirely in agreement with those of the above-mentioned experimenters. It was obvious that the most satisfactory substance for such determinations should contain both tellurium and iodine and be weighted with as little as possible of other elements. Such a substance is trimethyl tellurium iodide, which is easily prepared and purified, is very stable, and non-hygroscopic. When tellurium is heated to 80—100° in a sealed tube with methyl iodide (Demarçay, *Bull. Soc. Chim.*, 1883, **40**, 100), dimethyl tellurium di-iodide is readily formed; when this is treated with reducing agents in presence of methyl iodide, trimethyl tellurium iodide, $Te(CH_3)_3I$, is readily obtained. The corresponding bromide is a salt very well adapted for titration with silver by the method of Stas. Preliminary determinations so far agree with all the best results hitherto published in proving that the atomic weight of tellurium is nearly a unit higher than that of iodine.

In the following determinations, all the weights given are corrected for errors in face values of the weights, as well as being brought to vacuum standards:

$Te(CH_3)_3I$. AgI.
1·7461 gave 1·3688 ∴ $Te(CH_3)_3I$ = 299·62 and Te = 127·70.
6·6425 „ 5·20575 ∴ $Te(CH_3)_3I$ = 299·58 „ Te = 127·66.
8·0628 „ 6·3181 ∴ $Te(CH_3)_3I$ = 299·61 „ Te = 127·69.

By titration:

$Te(CH_3)_3Br$. Ag.
2·4294 required 1·0373 ∴ $Te(CH_3)_3Br$ = 252·79 and Te = 127·77.
6·8424 „ 2·9201 ∴ $Te(CH_3)_3Br$ = 252·90 „ Te = 127·88.

The second sample of bromide was not so pure as the first, as it was the second crop of crystals obtained from the mother liquors. The mean value is therefore Te = 127·74 taking all five determinations, or 127·70 if only the first four be taken.

Pellini gives 127·64.
Köthner „ 127·63.

The author indicated by a graphic representation of the quotients, $\frac{F}{O} = 1{\cdot}190$, $\frac{Cl}{S} = 1{\cdot}105$, $\frac{Br}{Se} = 1{\cdot}009$, $\frac{I}{Te} = 0{\cdot}993$, obtained by dividing the atomic weights of the halogen elements by those of the corresponding members of the oxygen group respectively, why he thought it very unlikely that the atomic weight of iodine should exceed that of tellurium.

In making the necessary calculations, the following values were taken: C = 12·00; H = 1·0075; I = 126·85; Br = 79·95 (O = 16).

Two syntheses of silver iodide were made, as follows:

Ag. AgI.
4·6240 gave 10·0634 ∴ AgI = 234·89 and I = 126·96.
6·39978 „ 13·92913 ∴ AgI = 234·91 „ I = 126·98.

Substituting I = 126·97 for I = 126·85 in the first three calculations increases the values for $Te(CH_3)_3I$ by 0·15, and those for Te by 0·03.

73. "Nitrogen bromides containing the propionyl group."
By F. D. Chattaway.

Propionanilide and the bromopropionanilides readily react with hypobromous acid, the imino-hydrogen being replaced by bromine, a hypobromite being probably formed as an intermediate product.

The action is a reversible one, and when nitrogen bromides are placed in water the opposite change takes place until a position of equilibrium is reached.

Except in colour, these nitrogen bromides closely resemble the corresponding nitrogen chlorides. All show the characteristic behaviour of the nitrogen halogen linkage, and readily react with hydriodic acid, sulphurous acid, hydrogen sulphide, alcohol, and potassium cyanide.

When an unsubstituted or partially substituted phenyl residue is attached to the nitrogen, they very readily undergo isomeric change.

Interchange between bromine attached to the nitrogen and hydrogen in the ortho-position in an unsubstituted nucleus has not been observed. Apparently the halogen cannot pass from the nitrogen to a meta-position.

All nitrogen bromides, when treated with an excess of hydrobromic acid, are decomposed, bromine being liberated and the corresponding anilide re-formed. On the other hand, when an anilide is treated with an excess of bromine, a nitrogen bromide and hydrobromic acid are produced.

A large excess of hydrobromic acid or the continuous removal of the free bromine causes the anilide to be re-formed, whilst the addition of a salt of a weaker acid which can remove the hydrobromic acid causes the action to proceed in the opposite direction and a nitrogen bromide is produced. The reversible nature of this reaction is most clearly seen when the nucleus is already fully substituted, as otherwise isomeric change and substitution into the ring may take place.

The following substances have been prepared:

Propionylphenyl nitrogen bromide, $C_6H_5 \cdot NBr \cdot CO \cdot C_2H_5$, pale yellow pyramids, m. p. 88°; p-*bromopropionanilide*, $C_6H_4Br \cdot NH \cdot CO \cdot C_2H_5$, rectangular plates, m. p. 149°; *propionyl*-p-*bromophenyl nitrogen bromide*, $C_6H_4Br \cdot NBr \cdot CO \cdot C_2H_5$, yellow prisms, m. p. 78°; *propionyl*-p-*bromophenyl nitrogen chloride*, $C_6H_4Br \cdot NCl \cdot CO \cdot C_2H_5$, colourless plates, m. p. 59°; o-*bromopropionanilide*, $C_6H_4Br \cdot NH \cdot CO \cdot C_2H_5$, colourless prisms, m. p. 93°; *propionyl*-o-*bromophenyl nitrogen bromide*, $C_6H_4Br \cdot NBr \cdot CO \cdot C_2H_5$, yellow prisms, m. p. 117°; *propionyl-o-bromophenyl nitrogen chloride*, $C_6H_4Br \cdot NCl \cdot CO \cdot C_2H_5$, colourless rhombs, m. p. 59°; 2:4-*dibromopropionanilide*, $C_6H_3Br_2 \cdot NH \cdot CO \cdot C_2H_5$, colourless needles, m. p. 136°; *propionyl* 2:4-*dibromophenyl nitrogen bromide*, $C_6H_3Br_2 \cdot NBr \cdot CO \cdot C_2H_5$, yellow rhombs, m. p. 87°; *propionyl* 2:4-*dibromophenyl nitrogen chloride*, $C_6H_3Br_2 \cdot NCl \cdot CO \cdot C_2H_5$, colourless plates, m. p. 71°; 2:4:6-*tribromopropionanilide*, $C_6H_2Br_3 \cdot NH \cdot CO \cdot C_2H_5$, colourless prisms, m. p. 203°; *propionyl* 2:4:6-*tribromophenyl nitrogen bromide*, $C_6H_2Br_3 \cdot NBr \cdot CO \cdot C_2H_5$, yellow prisms, m. p. 82°; *propionyl* 2:4:6-*tribromophenyl nitrogen chloride*, $C_6H_2Br_3 \cdot NCl \cdot CO \cdot C_2H_5$, colourless prisms, m. p. 75°.

The next meeting will be held on **Thursday, May 15th,** at **8 p.m.**

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Thursday, May 15th, 1902. Dr. W. H. Perkin, F.R.S., Vice-President, in the Chair.

Certificates were read for the first time in favour of Messrs :

James Handby Ball, St. Stephen's Villa, Limerick.
Bryce Chudleigh Burt, University Settlement, Bermondsey, S.E.
Arthur Crozier Claudet, 27, Daleham Gardens, Hampstead, N.W.
Edgar William Foll, 40, Sutton Street, Lambeth, S.E.
John Longsdon Garle, 136, Holland Road, Kensington, W.
George H. Leader, Sexey's School, Blackford, Somerset.
James Butler Moody, 111, Manchester Road, Burnley, Lancs.
Percy Philip Phillips, Haslemere, Morris Avenue, Manor Park, E.
William E. F. Powney, 67, Barretts Grove, Stoke Newington, N.
William C. S. Stanger, 72, Belle Vue Road, Ipswich.

Of the following papers, those marked * were read :

*74. "The variation with temperature of the surface-tensions and densities of liquid oxygen, nitrogen, argon, and carbon monoxide." By E. C. C. Baly and F. G. Donnan.

The measurements were made by the method of elevation in capillary tubes. The surface-tensions, molecular surface-energies, and densities of liquid oxygen, nitrogen, argon, and carbon monoxide have been determined between the temperatures of 70° and 90° (absolute). In the case of argon, owing to the proximity of its freezing and boiling points, measurements could only be made between 84° and 89°.

The relation between molecular surface-energy and temperature is found to be linear, thus agreeing with the results obtained by Eötvös and by Ramsay and Shields for non-associated liquids.

The values found for $\frac{d}{dt}\gamma(Mv)^{\frac{2}{3}}$, the temperature-coefficient of the molecular surface-energy, are as follows :

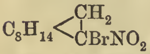
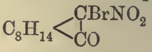
Oxygen....................	1·917
Nitrogen	2·002
Argon	2·020
Carbon monoxide	1·996

The average value obtained by Ramsay and Shields for non-associating liquids was 2·212.

Continuations of the straight lines connecting molecular surface-energy and temperature so as to cut the temperature-axis give values for the temperature which in the case of oxygen and nitrogen agree very closely with the critical temperatures as determined by Olszewski. In the case of argon and carbon monoxide, the temperatures so found do not agree with the critical temperatures as previously determined.

*75. "Comparison of bromonitrocamphane with bromonitrocamphor."

By M. O. Forster.

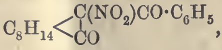
The close relationship between 1 : 1-bromonitrocamphane,  $C_8H_{14}<\begin{matrix}CH_2\\|\\CBrNO_2\end{matrix}$, and *αα*-bromonitrocamphor,  $C_8H_{14}<\begin{matrix}CBrNO_2\\|\\CO\end{matrix}$, led to the expectation that the series of changes by which the former substance is converted into a hydroxylic isomeride of camphor might be applied to bromonitrocamphor, and thus give rise to a hydroxylic isomeride of camphorquinone. Bromonitrocamphor was therefore heated with alcoholic silver nitrate until silver bromide was no longer precipitated. This treatment, which transforms bromonitrocamphane into nitrocamphene, $C_{10}H_{15}\cdot NO_2$, proceeds very slowly in the case of the camphor derivative, the solution becoming yellow. Instead of the expected nitro-compound, $C_{10}H_{13}O\cdot NO_2$, the only crystalline product obtained was camphorquinone. The yield of quinone by the new method amounted to 25 per cent. ; the process, therefore, compares favourably with that of Claisen, but is more tedious.

The comparison of bromonitrocamphane with bromonitrocamphor has been extended to the behaviour of these substances towards phenylhydrazine. The uncontrolled action of the base is exceedingly vigorous and yields no definite product ; under regulated conditions, however, bromonitrocamphane is reduced to nitrocamphane, which may be thus obtained in a purer form than has been possible hitherto. Nitrocamphane prepared by this method melts at 157° instead of 147—148°, and has $[\alpha]_D = +27{\cdot}0°$ in benzene, and $+7{\cdot}4°$ in absolute alcohol, instead of 20·4° and 4·6° respectively.

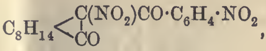
In the case of bromonitrocamphor, phenylhydrazine gives rise to nitrocamphor in a form which requires to be crystallised only once from petroleum to produce the substance in the colourless state, melting at 103° and giving $[\alpha]_D = -123{\cdot}8°$ in benzene; as the yield amounts to 84 per cent. of the theoretical, this method appears to be a distinct improvement on the existing process.

Bromine has no action on bromonitrocamphor under conditions which lead, in the case of bromonitrocamphane, to elimination of the nitro-group and production of a tribromo-derivative. Bromonitrocamphor is also indifferent towards nitric acid, which transforms bromonitrocamphane into a new lactone; alkalis eliminate hydrogen bromide from this compound, yielding salts of an unsaturated acid containing nitrogen. These derivatives are being investigated.

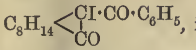
*76. "*αα*-Benzoylnitrocamphor and *αα*-benzoyliodocamphor." By M. O. Forster and E. A. Jenkinson.

αα-Benzoylnitrocamphor,  $\mathrm{C_8H_{14}}\Big<\begin{array}{l}\mathrm{C(NO_2)CO\cdot C_6H_5}\\ \mathrm{CO}\end{array}$, prepared by heating 5 grams of enolic benzoylcamphor dissolved in 25 c.c. of glacial acetic acid with 1·5 c.c. of fuming nitric acid, is also produced when nitrogen peroxide is passed into a solution of benzoylcamphor in dried chloroform. It requires 40 parts of boiling alcohol to dissolve it and is sparingly soluble in common solvents, crystallising in rectangular plates which melt and evolve gas at 225°. A 2 per cent. solution in chloroform has $[\alpha]_D = +245{\cdot}2°$. It is insoluble in aqueous alkalis, is indifferent towards ferric chloride, and does not give Liebermann's reaction.

Attempts to convert the substance into *αα*-benzoylaminocamphor and *αα*-benzoylhydroxylaminocamphor have been unsuccessful, but it is readily hydrolysed by alcoholic potash, yielding *α*-nitrocamphor and benzoic acid.

αα-Nitrobenzoylnitrocamphor,  $\mathrm{C_8H_{14}}\Big<\begin{array}{l}\mathrm{C(NO_2)CO\cdot C_6H_4\cdot NO_2}\\ \mathrm{CO}\end{array}$, produced when benzoylnitrocamphor is dissolved in fuming nitric acid, is more readily soluble than the foregoing substance, and crystallises from alcohol in pale yellow leaflets which melt and evolve gas at 176—177°; a 2 per cent. solution in chloroform has $[\alpha]_D = +190{\cdot}6°$.

Hydrolysis with alcoholic potash resolves the substance into nitrocamphor and *m*-nitrobenzoic acid.

aa-Benzoyliodocamphor,  $C_8H_{14}<\begin{matrix}CI\cdot CO\cdot C_6H_5\\ | \\ CO\end{matrix}$, is not obtainable by the methods which give rise to the benzoylbromocamphors and benzoylchlorocamphors; it is prepared by adding a solution of iodine in potassium iodide to enolic benzoylcamphor dissolved in aqueous potash. The compound crystallises from alcohol in pale yellow plates which become reddish-brown when exposed to light; it melts at 136°. A 2 per cent. solution in chloroform has $[\alpha]_D = +47{\cdot}7°$.

Benzoyliodocamphor is not converted into an isomeride by the action of hydrobromic acid, and hydriodic acid merely reduces it. Solutions in organic liquids rapidly undergo decomposition with liberation of iodine; ferric chloride soon produces a pale green colour, becoming bluish, and finally purple. Attempts to convert the substance into benzoylcyanocamphor and benzoylhydroxycamphor have been unsuccessful.

*77. "2:4-Dibromo-5-nitro- and 2:4-dibromo-3:5-dinitro-toluenes and their behaviour on reduction." By W. A. Davis.

On nitration with fuming nitric acid, 2:4-dibromotoluene gives 2:4-dibromo-5-nitrotoluene, which is converted by reduction with tin and hydrochloric acid into 4:6-dibromo-*m*-toluidine, the *acetyl* derivative of which crystallises from alcohol in small, white prisms (m. p. 167°.)

If the nitration of 2:4-dibromotoluene be not carefully regulated, 2:4-*dibromo*-3:5-*dinitrotoluene* is obtained. It crystallises from ethyl acetate in yellow prisms (m. p. 127·5°) and differs from all the other bromo- and dibromo-nitrotoluenes, as it loses the whole of its bromine on reduction with tin and hydrochloric acid, giving *s*-tolylenediamine; the *diacetyl* derivative, $C_6H_3Me(NHAc)_2$, crystallises from alcohol in small, hemimorphic prisms (m. p. 236—237°) and is strongly electric. The removal of the bromine atoms from 2:4-dibromo-3:5-dinitrotoluene during reduction is apparently due to the influence of the two contiguous nitro-groups.

*78. "Note on the purification of hydrochloric acid from arsenic." By L. T. Thorne, Ph.D., and E. H. Jeffers.

In the estimation of arsenic by the Marsh-Berzelius test, the use of hydrochloric acid is admittedly preferable to that of sulphuric acid. It is, however, practically impossible to purchase hydrochloric acid really free from arsenic, and it is therefore necessary to remove the last traces of arsenic from it in the laboratory.

The method recommended in the report of the Joint Committee of the Society of Chemical Industry and of Public Analysts (*Analyst*, 1902, 27, 48), namely, that of treatment of the diluted acid with hydrobromic acid or bromine and sulphurous acid and subsequent distillation is successful in most cases but occasionally fails, the arsenic then appearing to be present in a very stable or resistant form. Under these latter conditions, satisfactory results are said to be obtained if the hydrobromic and sulphurous acids are added to the *strong* hydrochloric acid and the excess of hydrochloric acid gas boiled off before distillation commences. If large quantities of hydrochloric acid are wanted, this method is inconvenient and wasteful, owing to the large quantities of hydrochloric acid gas evolved.

The whole of the arsenic may readily be removed by means of a modification of the well-known Reinsch test for arsenic in the following manner.

The hydrochloric acid to be purified is diluted with water till its specific gravity is about 1·10, then raised to the boiling point, and a piece of fine copper gauze introduced. The gauze should be of about 100 meshes to the inch, and of as pure copper as possible. When a couple of litres of liquid are being dealt with, the gauze should be about four inches square and coiled very loosely (about 1½ to 2 turns) round a long glass rod flattened at the end, as in this way it can be readily introduced and removed, besides being brought into better contact with the liquid. The whole is then kept just boiling for an hour. By this time, the gauze will have become more or less blackened, and should be replaced by a second piece and the digestion continued for another hour. If this piece is also blackened, a third is used, and so on, until the gauze remains perfectly bright after about an hour's digestion. With moderately good acid, two, or at most three, pieces of gauze are sufficient. The gauze is then removed, and the acid at once transferred to a retort and distilled from a fresh piece of gauze. It is advisable, as a precaution, to reject the first 20 per cent. of the distillate, though even this is very rarely contaminated if the digestion is carefully carried out, and from 100 to 200 c.c. should be left behind in the retort. The method is simple and requires but little attention, and it is not necessary to use the purest acid; even good muriatic acid, "commercially free from arsenic," may be satisfactorily employed. The acid obtained is the constant boiling point acid, which is about the most suitable strength for use in the Marsh-Berzelius test.

The gauze must, of course, be gently ignited before being used, and should not be introduced until the acid is just beginning to boil. It is also preferable not to allow the digested liquid to cool in contact with the air before transferring it to the retort, as the copper gauze would be much attacked and its efficiency for the present purpose considerably lessened by the consequent oxidation.

79. "The radioactivity of thorium compounds. Part II. The cause and nature of radioactivity." By E. Rutherford and F. Soddy.

The authors find that thorium from which ThX has been separated regains its activity with time, whilst the activity of ThX decreases with time. At the end of three weeks, the activity of the former again reached a maximum value, and the activity of the latter almost completely disappeared.

ThX possesses a distinct chemical behaviour which differentiates it from thorium. Ammonia is the only reagent of those tried capable of separating it from the latter. Ammonium carbonate, oxalic acid, and sodium phosphate give precipitates with normal activity, and the residues from the filtrates are inactive.

Using the radioactivity of the residues from the filtrates after precipitation of the thorium by ammonia, as a means of determining the amounts of ThX present, it was found that the amounts produced in varying intervals of time between successive precipitations agree with the requirement that ThX is being continuously produced by thorium compounds at a constant rate.

The rate of production of ThX and the rate of decay of its activity are apparently unaffected by known agencies. Both changes proceed independently of the chemical and physical conditions of the molecule.

The source of the energy required to maintain the radioactivity of thorium over indefinite periods is therefore to be found in a chemical change producing new types of matter.

Many of the results obtained by the authors in their investigation of the thorium emanation are now capable of explanation. Emanating power appears as a property of ThX and not of thorium, and is proportional to the activity of the ThX present. The decay and recovery of emanating power of ThX and thorium are completely analogous to the decay and recovery of radioactivity. These results find their simplest explanation in the view that a secondary change is proceeding in ThX. One of the products is gaseous, and in the radioactive state constitutes the emanation. This change appears more allied to ordinary chemical reaction than the primary, for it is affected by the conditions.

The residual activity of thorium would be explained if the chemical change which produces ThX produces also a second kind of active matter, closely allied to thorium in its properties. The radiations of this residual part are composed entirely of rays non-deviable in the magnetic field, whereas the other two components of thorium radioactivity comprise both deviable and non-deviable radiation. In this respect, uranium and thorium are analogous (compare following paper).

The present result, that radioactivity is the consequence of changes —independent of the conditions—in which new types of matter are formed, leads to the conclusion that radioactivity is the manifestation of sub-atomic chemical change.

80. "The radioactivity of uranium." By F. Soddy.

During an investigation of the radioactivity of uranium (conjointly with Prof. Rutherford), great differences arose between the results obtained and those of previous workers. These are traced to the methods employed for measuring radioactivity.

UrX, prepared by Crookes' original method (*Proc. Roy. Soc.*, 1900, **66**, 409), although intensely active to the photographic plate, is almost inactive to the electrometer under ordinary circumstances. The uranium from which it is separated is inactive to the sensitive film, but its activity to the electrometer is very nearly normal.

This is due to the dual character of uranium radiation (Rutherford, *Phil. Mag.*, 1899, [v], **47**, 109). The α- or easily absorbed radiation is without appreciable action on the photographic film, and contributes by far the major portion of the ionisation effect observed by the electrometer. The β- or penetrating radiation, on the other hand, causes the whole of the photographic effect, but being little absorbed by gases, and constituting but a small proportion of the total radiation, its ionisation effect cannot be well observed by the electrometer without special arrangements.

UrX possesses all the β- with none of the α-radiation, the latter being completely retained by the uranium. The β- is wholly deviable in the magnetic field, the α-radiation not at all. This explains the conclusion of Becquerel (*Compt. rend.*, 1902, **134**, 208), who worked solely with the photographic method, that the whole of the uranium radiation is deviable in the magnetic field.

The discovery of Becquerel that inactive uranium recovers its activity with time (*Compt. rend.*, 1901, **133**, 977) therefore points to a continuous production of UrX by the uranium. This continuous production can be observed by means of the β-radiation in uranium originally freed from UrX after three days.

The published methods of Crookes (*loc. cit.*) and Becquerel (*Compt. rend.*, 1900, **131**, 137) fail to remove the α-radiation of uranium, or even to diminish its quantity. As in the case of thorium, this constitutes a residual activity comprising only non-deviable radiation, and it has not yet been found possible to remove it by chemical means. Experiment shows that if it is a secondary radiation caused by UrX, it must take over a year to decay to half its value after the exciting cause is removed. It seems therefore more probable that it is caused by a second type of non-uranium matter, produced from the uranium by the same change as he UrX.

ADDITIONS TO THE LIBRARY.

I. *By Donation.*

Paetzold, Ernest. Beiträge zur pharmacognostischen und chemischen Kenntnis des Harzes und Holzes von Guajacum officinale L., sowie des "Palo balsamo." Pp. 117. Strassburg i. E. 1901. From Ed. Schaer.

Ingle, Herbert. Manual of agricultural chemistry. Pp. 412. London 1902. From the Author.

Böttger, Wilhelm. Grundriss der qualitativen Analyse vom standpunkte der Lehre von den Ionen. Pp. 249. Leipzig 1902. From the Author.

II. *By Purchase.*

Windisch, Wilhelm. Das chemische Laboratorium des Brauers. Anleitung zur chemisch-technischen Betriebskontrolle für Studierende und Praktiker. Pp. 373. Berlin 1902.

Long, John H. A text-book of urine analysis for students and practitioners of medicine. Pp. 249. Chicago 1900.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 9th.

At the next meeting, on **Wednesday**, May 28th, at **5.30.** p.m., the following papers will be communicated :—

"Taxin." By T. E. Thorpe, C.B., F.R.S., and G. Stubbs.
"Some excessively saline Indian well waters." By J. W. Leather.
"Soil samples." By J. W. Leather.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 253.

Wednesday, May 28th, 1902. Professor Meldola, F.R.S., Vice-President, in the Chair.

Messrs. J. W. Peck, J. C. Crocker, and J. Kewley were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Edwin T. H. Bucknell, Ebley House, Parsonage St., Dursley, Glos.
Francis E. Francis, 8, Manilla Rd., Clifton, Bristol.
George Paton Pollitt, Ph.D., St. Silas Rd., Blackburn, Lancs.
Harold James Roast, 3, Manor Park Rd., Harlesden, N.W.
Edward J. Wheeler, Albany, State of New York, U.S.A.

Of the following papers, those marked * were read:

*81. "Taxine, the alkaloid of yew." By T. E. Thorpe, C.B., F.R.S., and G. Stubbs.

The investigation has been carried out on autumn-gathered leaves of male and female trees of the species *Taxus Baccata.* The alkaloid was extracted by digesting the powdered, air-dried leaves with 1 per cent. sulphuric acid for 5 or 6 days. The acid liquid was strained and pressed from the leaves, and at once, without concentration, rendered alkaline and extracted with ether. Taxine was obtained in the form of very fine, glistening particles by crushing down the residue from the ether extract. It gives precipitates with most of the alkaloidal reagents, and colour reactions with strong sulphuric acid alone, and when this reagent is mixed with nitric acid, molybdic acid, or chromic acid.

Taxine is very susceptible to change. At least two substances result from the action of dilute acids upon it, but owing to lack of material the authors have not yet completed their investigation of these products.

Several salts have been prepared and analysed. Two compounds with gold chloride have been obtained which have the formulæ $C_{37}H_{52}NO_{10},HAuCl_4$ (m. p. 72·5°) and $C_{37}H_{52}NO_{10},AuCl_3$ (m. p. 132—134°) respectively. The methyl iodide compound, $C_{37}H_{52}NO_{10},CH_3I$ (m. p. 121°), has been prepared as a white, amorphous powder by mixing benzene solutions of the alkaloid and methyl iodide.

Although the analytical figures deduced, both for taxine and its salts, are in substantial agreement with the formula, $C_{37}H_{52}NO_{10}$, given by Hilger and Brande (*Ber.*, 1890, 23, 464), the authors are not of opinion that this formula is definitely established.

The alcoholic extract of yew, amounting to about 26 per cent. of the dry leaves, is at present under examination.

DISCUSSION.

Prof. **DUNSTAN** remarked that the authors had confirmed the accuracy of previous work on the properties of taxine, and he hoped that they would now be able to go further and throw some light on its chemical structure. It had not been yet fully proved that yew-poisoning was due to the presence of taxine, and indeed even the exact conditions under which yew becomes poisonous did not appear to have been determined with certainty.

Mr. **GOLDING** said that in the year 1893 he had assisted Mr. Dymond in an investigation of the alkaloid of the yew. They found that drying the leaves at 100° destroyed the alkaloid.

The extraction of the alkaloid was made from bruised, green, freshly-gathered leaves by Marmé's process, which was repeated several times to purify the alkaloïd. Further purification was effected by adding light petroleum to the ether solution, the fractions thus obtained giving the characteristic reactions of taxine.

When dry hydrogen chloride was passed into a solution of the alkaloid in anhydrous ether, and a crystalline precipitate was formed, which soon changed to a dark brown paste, phenomena also observed by Hilger and Brande.

Cases were on record of animals eating yew with impunity, and a large number of the cases which had proved fatal were due to the eating of *withered* branches.

Dr. VOELCKER pointed out that the uncertainty with regard to poisoning by yew extended to the kind of animal eating it as well as the condition of the leaves. A good deal also depended on the conditions under which it was eaten, whether, for example, much grass or other food was eaten along with it. He thought that it was very desirable that the other substances which the authors had obtained should also be studied, but regarded it as essential that the yew examined should be freshly gathered, and not kept for some considerable time as in the case of that employed by the authors.

Mr. STUBBS, in reply, said that no work had been done to ascertain if the alkaloid contained methyl groups. He did not think that the substance had been produced by the action of the acid used for extraction upon a glucoside. The material employed had been dried in air, at a temperature not exceeding 60°. They had obtained the same amounts of alkaloid from the leaves both when freshly gathered and after they had been dried.

*82. "The sampling of soils." By J. W. Leather.

Experiments were made in India to determine the accuracy of the auger method of sampling soils, and the agreement between the samples was tested by determinations of the total nitrogen, the available phosphoric acid, and the available potash. The results showed that in most cases the agreement was very good between samples, but that in some cases the divergence exceeded 1 in 20, an amount which the author considered too great.

The amounts of phosphoric acid in some of the Rothamsted wheat soils, as found by Dyer, were considered with a view to determine the accuracy of the method of sampling which was there employed. The author considered that such a comparison indicated the Rothamsted method to have yielded as good results as the auger method. Both, however, fall short of what is expected in taking samples of commercial products, and it was urged that the newer methods of soil investigation demand more accurate methods of sampling.

DISCUSSION.

Dr. DYER said that it seemed obvious that a sample drawn from many parts of the field was more likely to be accurately representative than a sample drawn from one or few places. Nevertheless, it seemed to him that Dr. Leather's analytical results, obtained on samples drawn from different parts of the same field, instead of indicating differences in the samples, appeared really to indicate that both the sampling and the analytical work were excellently performed. Some of the analytical figures regarded by Dr. Leather as discrepant, he (the speaker) should himself regard as being in very good agreement. As to the results of his determinations of phosphoric acid in the Rothamsted wheat soils, which Dr. Leather had quoted, it must be remembered that, whilst the samples analysed represented only the first nine inches of soil, the phosphoric acid removed in the crops might, in the case of wheat, on many plots, be drawn to a considerable extent from the subsoil; and that the influences of vegetation might considerably affect the distribution of soil constituents in the various layers of the soil and subsoil. The "original" phosphoric acid of Broadbalk field, as calculated back from the present contents and known additions and removals, showed, on the whole, as Dr. Leather had pointed out, a fair uniformity, though there were some discrepancies. It was, however, quite probable that the percentage of phosphoric acid in the surface soil was originally by no means uniform on the different plots. Certain of the plots had long behaved somewhat anomalously, indicating some inherent physical or chemical differences in the soil or subsoil.

Dr. **Voelcker** was inclined to agree with Dr. Dyer, and to regard the results which Dr. Leather had obtained as being very satisfactory. and as agreeing well with one another. It would hardly be a matter for surprise to those who had followed the work at Rothamsted, and who knew the infinite pains which the late Sir Henry Gilbert always took to ensure accuracy in every detail, to learn that Dr. Leather's estimate of gains and loses showed that there could not be much amiss with the Rothamsted method of soil-sampling. Still, it was obvious that the more places in which borings of a soil were taken for sampling purposes the more representative would that sample be.

There was considerable difference between soil samples taken as at Rothamsted (where at least three holes were selected on each plot), and the block of soil ordinarily sent by a farmer when he wished his soil analysed. In the latter case, no doubt, the method Dr. Leather suggested would give a much more representative sample.

The difficulty was in the case of soils of stony character, or where lumps of chalk occurred. The auger might very readily, by pushing these stones or lumps aside, or by including them in the boring, ultimately cause a considerable difference in the analysis.

Mr. **Hall** said that for some years he had been using an auger for taking samples in the Soil Survey of Kent and Surrey they were carrying out. They used a cylindrical auger one foot long, two inches in diameter, with a slot one inch in breadth, the sides of the slot, and the bottom of the cylinder being each sharpened to a cutting edge. The worm auger was only used for exploring the subsoil to some depth. The auger was undoubtedly most useful for securing a fair sample, especially in field work, where one did not want to be burdened with a great weight of soil; but there were many soils on which it could not be used, they were either too hard, too stony, or too loose to remain in the tool. The steel box employed at Rothamsted could be made to give the most accurate results, but it was not wise to lay down any hard and fast rule as to which was the best tool. The analyst must examine the soil, and then use his judgment.

As to Dr. Leather's figures, not only did they support his opinion that fair samples could be drawn with the auger, but they showed that he must have been working with an extremely uniform soil, probably of alluvial origin. In England samples taken from adjoining fields on the same formation would vary between far wider limits than those shown by Dr. Leather's figures.

Dr. LEATHER, in reply, said that so far as stones are concerned, the determination of their amount would naturally demand that comparatively large portions of soil should be taken, but this consideration would not apply to the examination of the fine earth. Of the Indian soils examined, that at Cawnpore is alluvial, but the geological history of the Poona land is uncertain.

*83. "Some excessively saline Indian well waters." By J. W. Leather.

The composition of some well waters from the Muttra District, United Provinces, India, was given in detail. These waters contain from 200 to 2000 parts of salt per 100,000 of water. About one-half of the saline matter consists of sodium chloride; the amount of carbonate is about 20 to 30 parts; the nitrate varies from nothing to 250 parts; very large amounts of sulphate were present in some of the samples. In three cases, there was an excess of lime over that required to combine with the nitric, carbonic, and sulphuric acids, thus proving the presence of calcium chloride.

Some of these waters are used for irrigating crops. The soil of the district is open, the drainage conditions are good, and no salts accumulate in the surface soil. These waters provide an indication therefore of the maximum strength of solutions in which plants can grow, a point which is of importance in connection with the alkali lands of America, and the Usar lands of India. It is found practically that, of these well waters, those may be employed for irrigating crops which do not contain much more than about 500 parts of salts per 100,000, or 0·5 per cent.

The amount of salts in Usar or alkali land is usually stated in parts in 100 of soil, and it is found in practice that soils containing much more than 0·1 per cent. are infertile. Immediately after irrigation, such a soil would contain a solution of about 0·33 of salts per 100 of water, but after the lapse of a few days, the proportion of water decreases to 10 or 15 per cent., and in this state the above mentioned solution would become concentrated to about 1·0 or 0·66 per cent. respectively. These figures correspond practically with what is known about the well waters.

DISCUSSION.

Mr. J. SPILLER said that in the year 1865 he had occasion to examine some remarkable products obtained from a highly saline spring which discharged itself into Lake Lohhar, India. The water left on evaporation 8·25 per cent. of solid residue, which consisted roughly of two parts of common salt to one of sodium carbonate. A local attempt at a separation of these resulted in a purified product, which had the following composition :—

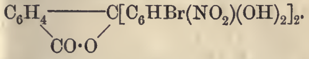
Sodium carbonate	75·0
,, chloride	0·6
Calcium carbonate	1·9
Sand and ferric oxide	2·7
Water, nearly	20·0

There was no sulphate, bromide, borate, or nitrate.

*84. "Nitrobromo-derivatives of fluorescein." By J. T. Hewitt and A. W. G. Woodforde.

The non-fluorescence of alkaline solutions of nitro-derivatives of fluorescein was explained by the assumption that the alkaline salts of orthonitrophenols have the metal attached to the nitroxyl and not to the hydroxyl group (Hewitt and Perkins, *Trans.*, 1900, 77, 1324). With regard to the position of the nitro-groups in dinitrofluorescein, it was assumed that these occupied positions 2 and 7. (The numbering of the fluoran ring corresponds to Richter's numbering in the xanthene nucleus.)

Additional support was lent to this view by the isolation from the product of alkaline fusion of a small amount of material having a melting point of 114°. Since 4-nitroresorcin melts at 115°, the substances were supposed to be identical, and hence positions 2 and 7 were assigned to the nitro-groups in the fluoran nucleus. It is now shown, however, that this view must be discarded; by adopting suitable precautions, 2-nitroresorcin may be isolated in considerable quantity, as had been previously demonstrated by Matras; the authors' thanks are due to M. Reverdin of Geneva for calling their attention to this work.

Dinitrofluorescein is thus 4:5-dinitrofluorescein; acted on by bromine, 4:5-dinitro-2:7-dibromofluorescein results. This substance closely resembles the original dinitrofluorescein, it dissolves in alkalis with a brown colour, but on warming a blue solution is obtained from which acids precipitate the hydrate 
$$\begin{array}{l} C_6H_4\text{———}C[C_6HBr(NO_2)(OH)_2]_2. \\ \quad\;\diagdown\quad\;\;\diagup \\ \quad\quad CO\cdot O \end{array}$$

4:5-Dinitro-2:7-dibromofluorescein has been further characterised by its *diacetyl* derivative, $C_{20}H_6Br_2N_2O_9(C_2H_3O)_2$, m. p. 276°; *dibenzoyl* derivative, $C_{20}H_6Br_2N_2O_9(C_7H_5O)_2$, m. p. 315°; *sodium* salt, $C_{20}H_6Br_2N_2O_9Na_2,2H_2O$.

Dibromofluorescein, $C_{20}H_{10}Br_2O_5$, obtained by Bayer by the limited action of bromine on fluorescein, is evidently also a 4:5-substitution derivative, since nitric acid produces from it a dinitro-derivative quite distinct from the 4:5-dinitro-2:7-dibromo-compound. The *benzoyl* derivative, $C_{20}H_8Br_2O_5(C_7H_5O)_2$, melts at 240—244°. 2:7-*Dinitro*-4:5-*dibromofluorescein* may be obtained either by the action of nitric acid upon 2:7-dibromofluorescein or of bromine upon 2:4:5:7-tetranitrofluorescein. This substance dissolves in alkalis with a magnificent purple colour not altered by boiling. Nitro-groups only render the pyrone ring unstable if in the ortho-position relatively to its oxygen atom; this is also shown by the action of ammonia, which reacts with 4:5-dinitro-2:7-dibromofluorescein, apparently in a similar manner to that observed by Reverdin in the case of dinitrofluorescein, whilst with 2:7-dinitro-4:5-dibromofluorescein it merely produces an ammonium salt.

The *diacetyl* derivative, m. p. 215°, *dibenzoyl* derivative, m. p. 301°, and *sodium* salt of 2:7-dinitro-4:5-dibromofluorescein have been prepared.

85. "On phosphorus sesquisulphide and its behaviour with Mitscherlich's test." By E. G. Clayton, F.I.C.

Many compounds of phosphorus and sulphur have been described, but of these the only one which has received any application on the large scale is the sesquisulphide, P_4S_3, discovered by Lemoine in 1864. When pure, it is a lemon-yellow, crystalline solid, with a strong odour of hydrogen sulphide, soluble at 15° in 1·6 parts of carbon bisulphide, and igniting in the air at about 100°. Commercially, several qualities of this substance are manufactured. Amongst those which have come under observation have been a coarsely granular, lemon-yellow powder; a fine-grained, yellow powder of somewhat duller tint; and a grey product, sometimes very impure. The following are typical analyses:

	A. Yellow (fine-grained).	B. Yellow (fine-grained).	C. Yellow (coarse-grained).	D. Grey (finely granular).
Water and volatile matter (loss at 100°, in an atmosphere of carbon dioxide)	0·19	0·18	8·74	7·31
Phosphorus sesquisulphide, P_4S_3	97·86	97·62	84·95	83·34
Red phosphorus	—	—	—	1·81
Phosphoric acid, H_3PO_4	1·30	1·63	2·14	1·23
Sulphur, uncombined (soluble in carbon bisulphide)	—	—	4·17	—
Sulphur, uncombined (insoluble in carbon dioxide)	0·46	0·40	—	0·17
Calcium phosphate	—	—	—	3·35
Calcium sulphate	—	—	—	0·27
Iron oxide, &c.	—	—	—	1·72
Siliceous matter	0·19	0·17	—	0·80
	100·00	100·00	100·00	100·00
Temperature at which the specimen became luminous in the dark	92°	93°	—	58°
Temperature of ignition	94	96	86°	72
Reaction with Mitscherlich's test	negative	negative	distinct	distinct

Mörner has recently stated (*Svensk Farmaceutisk-Tidskrift*, 1901, 12, 177) that phosphorus sesquisulphide gives "more or less positive results" with Mitscherlich's test for phosphorus. The author has examined various specimens of commercial phosphorus sesquisulphide, and applied Mitscherlich's test to each in the following way: 20 grams of the compounds were distilled with 100 c.c. of 10 per cent. sulphuric acid, in an egg-shaped flask connected with a spiral condenser, the operation being conducted in a dark room. The very small amount of light emitted by the lamp was screened from the condenser and receiver, which were in complete darkness. In each case, 40 c.c. of liquid were distilled over. The results with comparatively pure specimens, such as A and B, were absolutely negative, not the faintest luminosity being perceptible in any part of the apparatus. It is evident that pure, or even approximately pure, phosphorus sesquisulphide gives no reaction with Mitscherlich's test, and that Mörner's results were obtained with samples containing small quantities of phosphorus, or of phosphorous oxide. Very crude specimens of phosphorus sesquisulphide no doubt occasionally give Mitscherlich's reaction: thus, with the impure specimen, D (tested after being kept for many months in the laboratory), a distinct luminous cloud played about the exit of the condenser, and in the air of the receiver above the surface of the distillate, which had a faint odour of phosphorous oxide. The sample C, which had been kept for nearly three years, and had undergone considerable oxidation, being quite moist, also gave a decided reaction. The distillate from this also smelt distinctly of phosphorous oxide. The specimens A and B, which gave negative results, had been recently made. Even in these samples some oxidation had occurred, but apparently no phosphorous oxide was present. The author is now conducting some experiments with the object of discovering whether exposure and keeping can so induce partial oxidation in, or alter the composition of, pure, or nearly pure, phosphorus sesquisulphide as to impart to it after a time the property of giving Mitscherlich's reaction. Apart from its scientific interest, the point was of considerable practical importance. Meanwhile, the absence both of free phosphorus and of phosphorous oxide from phosphorus sesquisulphide of fair quality and purity and comparatively recent manufacture was clearly indicated by the negative reaction with Mitscherlich's test, and the following circumstances were corroborative as far as they went. Phosphorus sesquisulphide may be subjected to friction in air at a temperature very considerably exceeding the ignition point of phosphorus without becoming luminous, and with a total absence of "phosphorus fume"; it neither ignites nor begins to glow in the dark until a temperature of 92—96° is reached, and the finely divided residue of a solution in carbon bisulphide, evaporated on filter-paper at the ordinary temperature, neither glows in the dark, fumes, nor ignites spontaneously.

86. "Atomic and molecular heats of fusion." By P. W. Robertson.

No satisfactory relationship has hitherto been found connecting the latent heat of fusion of substances with their atomic or molecular weights. In the case of the elements, the following is shown to yield satisfactory results. "For the elements with atomic weights above 40 which do not expand on freezing, the atomic heat of fusion divided by the melting point on the absolute scale into the cube-root of the atomic volume is a constant." That is, $Aw/T\sqrt[3]{V} =$ constant.

The numbers have a mean variation of ± 10 per cent. The only exception is lead, for which the value of the expression is 25 per cent. below the mean.

In the case of the binary inorganic compounds also, the expression $Mw/T\sqrt[3]{V}$, where V is the specific volume of the solid, yields concordant results. The values of the expression for organic compounds increase with the number of atoms in the molecule, but when compounds of similar constitution are considered, fairly constant results are obtained.

To test these relations, the latent heats of the following substances were determined :

Thallium = 7·2
Lead = 6·45
Tin = 14·05
Dinitrobenzene = 29·0
Phenanthrene = 25
Phenylacetic acid = 32
Tribromophenol = 13·4
Tribromoaniline = 14·4
Thiosinamine = 33·4.

87. "The preparation of mixed ketones by heating the mixed calcium salts of organic acids." By E. B. Ludlam.

A device for preparing a simple ketone from the calcium salt of the corresponding organic acid was described by Young (*Trans.*, 1891, 59, 623), which consisted in decomposing the salt at the temperature of boiling sulphur and removing the products by a stream of carbon dioxide.

The author has extended the method to mixtures of calcium salts with very satisfactory results.

The conclusions arrived at are : (i) That the decomposition is not of one molecule, but of two. (ii) There is a greater tendency towards the production of the mixed than of the simple ketone. (iii) That, for economy, it is advisable to distil the more expensive salt with excess of the cheaper one. By so doing the yield of mixed ketone from a given weight of the expensive salt is increased.

88. "Isomeric additive products of methyl, ethyl, and propyl benzyl ketone with benzylidene aniline. Part IV." By F. E. Francis and E. B. Ludlam.

The benzylideneaniline additive products of methyl, ethyl, and propyl benzyl ketones were prepared in the expectation that they would furnish evidence as to the constitution of the tautomeric forms which such compounds are capable of assuming. Methyl benzyl ketone contains the group $CH_3\cdot CO\cdot CH_2-$, which in ethyl acetoacetate gives rise to the tautomeric form $CH_3\cdot C(OH)\colon CH-$, and it was hoped that the work would have contributed to the solution of the problem of the constitution of the tautomeric forms of that compound.

Methyl benzyl ketone gave with benzylideneaniline an additive product melting constantly at 173° (α). This, under the influence of piperidine, gave the β-modification melting at 182°, and another modification melting at 184° when subjected to the action of a trace of sodium ethoxide. The hydrochloride of the α-modification was unstable; it gave no fixed melting point, but slowly decomposed between 140° and 190°. Propyl benzyl ketone gave a similar α-product, crystallising in silky needles melting at 136°, rising to 142° under the influence of piperidine, and to 143° with sodium ethoxide. Ethyl benzyl ketone gave an α-product melting at 161°, intermediate between 136° and 173°. Neither the original ketones nor any of the additive products gave any coloration with ferric chloride, and the melting points of the β- and γ-varieties fell when they were recrystallised from pure benzene. They were thus too unstable to serve the purpose for which they were prepared.

89. "The influence of solvents on the rotation of optically active compounds. Part III. Influence of benzene, toluene, *o*-xylene, *m*-xylene, *p*-xylene, and mesitylene on the rotation of ethyl tartrate." By T. S. Patterson.

It was found that in dilute solution the influence of benzene is to lower slightly the specific rotation of the dissolved ethyl tartrate. Toluene has a greater influence of the same kind, and this influence becomes greater and greater in the other solvents in the order in which they are placed above.

It was found also that in benzene, toluene, *o*-xylene, and *m*-xylene there exists, not only a concentration of minimum rotation, but also one of maximum rotation, which lies at a greater dilution. The concentration-rotation curves for *p*-xylene and mesitylene show only a point of inflection.

The relationship between molecular-solution-volume and rotation has been investigated, and it was found that in general, although not without exception, the behaviour was the same as in the monohydric alcohols; when the dissolved ethyl tartrate has a molecular-solution-volume greater than the molecular-volume of the pure ester the rotation is correspondingly low.

The relationships between rotation, latent heat of vaporisation of the solvent, and surface tension of the solvent were also discussed.

90. "The influence of solvents on the rotation of optically active compounds. Part IV. Influence of naphthalene on the rotation of ethyl tartrate." By T. S. Patterson.

Naphthalene was found to differ greatly in its behaviour from the benzene hydrocarbons. It has the effect of greatly increasing the rotation of the dissolved ethyl tartrate, and its influence is similar to that of water in this respect as well as in the effect of temperature change.

Thursday, June 5th, 1902. Professor Thorpe, C.B., F.R.S., Vice-President, in the chair.

Messrs. Steel, F. King, S. King, West, and F. M. Perkin were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Edgar Leeder Edlin, B.A., Marsh Parade, Newcastle, Staffs.
George Felix Dudbridge Green, 9, Ross Road, South Norwood, S.E.
Arthur Francis Hosking, Roskear Villas, Camborne, Cornwall.
Douglas K. Jardine, B.Sc., 20, Doune Terrace, Kelvinside, Glasgow.
Leonard Smith, 14, West Hill, Highgate, N.

The certificate of Mr. Herbert Purtan, London Chambers, Durban, Natal, authorised by the Council under Bye-law I (3) was read.

Of the following papers, those marked * were read:—

*91. "The action of ungerminated barley diastase on starch. Part I.'

By J. L. Baker.

When the diastase from ungerminated barley is allowed to act at 50° on a solution of soluble starch, hydrolysis proceeds until at the end of an hour to an hour and a half the constants of the dissolved matter are $[\alpha]_{D3\cdot93} = 160-165°$ and $R_{3\cdot93} = 60-65°$. After this the reaction is a comparatively slow one, and if continued for 96 hours the reducing power is only increased to $R_{3\cdot93} = 70$, the iodine reaction being still blue.

An examination of the products, after the reaction had proceeded for $1\frac{1}{2}$ to 2 hours, showed that a dextrin and maltose were the sole products. After 24 hours, evidence of the presence of glucose was obtained, the amount of this sugar apparently increasing in proportion to the time of conversion.

The dextrin, isolated by precipitation with alcohol from the products of the conversion, gave a blue iodine reaction, a specific rotation of $[\alpha]_{D3\cdot93} = 190-195°$, and a reducing power of $R_{3\cdot93} = 0\cdot55-1°$. The alcoholic solutions from which the dextrin was precipitated were collected and examined and found to contain maltose, glucose if the conversion period was prolonged, but no trace of any dextrin of less complexity than described above.

Barley diastase acts on the above-mentioned dextrin very slowly, the constants of the solution after 90 hours at 45—50° being $[\alpha]_{D3\cdot93} = 160°$ and $R_{3\cdot93} = 32°$. The products, which give a blue iodine reaction, consist of maltose, unaltered dextrin, and glucose. The presence of glucose could be detected in 18 hours, but after 90 hours the amount formed had only slightly increased. The action of malt diastase on this dextrin was more vigorous. After 18 hours at 55° the solution, which no longer gave an iodine reaction, had the constants $[\alpha]_{D3\cdot93} = 149\cdot3°$ and $R_{3\cdot93} = 50—51°$. An examination of the products showed that they consisted of maltose, a mixture of achroo-dextrins, and a considerable quantity of glucose.

Since barley diastase is without action on maltose, the glucose found in the products from the prolonged action of barley diastase on soluble starch must be derived from the dextrin. Barley diastase completely liquefies starch paste in 2 to 3 hours at 50°, the products consisting of the above described dextrin and maltose.

The dextrin obtained by the action of barley diastase on soluble starch or starch paste differs markedly from Nageli's "amylodextrin," which was reinvestigated by Brown and Morris (Trans., 1889, **55**, 449). In consideration of its general behaviour and close relation to the parent substance starch, the author proposes to term the new dextrin *α-amylodextrin.*

DISCUSSION.

Mr. A. R. LING asked if the author had continued the reaction between barley diastase and soluble starch solution for a longer period than 144 hours, in fact until (when working with an excess of the diastase) the final point was reached. It had recently been shown by Mr. B. F. Davis and himself that by the action of the diastase from air-dried malt on starch paste below 60°, the whole of the starch was converted into maltose in 40 hours. He had been struck by Mr. Baker's observation that maltose was practically the sole cupric-reducing compound formed in the early stages of the reaction between barley diastase and starch solution. With regard to the dextrin which the author had named α-amylodextrin, and which gave a blue iodine reaction, he could not help thinking, in view of what was known of starch-conversion products, that this dextrin (despite its apparent stability towards barley diastase) must have contained soluble starch. An indication of this was afforded by the behaviour of the dextrin towards malt diastase when the iodine reaction vanished.

Mr. BAKER, in reply, said that with regard to the suggestion of Mr.

Ling and Dr. Thorne, that α-amylodextrin was a mixture of another dextrin and unaltered soluble starch, he was convinced that α-amylodextrin was an entity, from the fact that when this dextrin was acted on by barley diastase for 18 hours at 50°, it split up into maltose and unaltered α-amylodextrin. If this residual α-amylodextrin was then subjected to the action of barley diastase under similar conditions, the same products were formed. This treatment had been repeated many times, and it did not seem possible that under such circumstances, soluble starch could escape the action of barley diastase.

*92. "The decomposition of chlorates. Part V. Potassium chlorate in presence of oxides of manganese, and the theory of perchlorate formation." By W. H. Sodeau, B.Sc.

In continuation of the previous work of the author, it was now shown that the amount of chlorine accompanying the oxygen evolved from potassium chlorate in presence of oxides of manganese was not increased on reducing the pressure under which the decomposition took place, whilst secondary reactions removing free chlorine from gaseous products have previously (*Trans.*, 1901, 79, 251) been experimentally shown to be greatly decreased on decomposition under reduced pressure. It was thus seen that no such secondary reaction occurred in the present case.

This excludes all theories which assume the cycle of changes to include the formation of a compound containing manganese and chlorine or potassium and manganese, such as McLeod's well known theory. Oxygen being the only remaining constituent, it followed from this process of exclusion that the cycle of changes brought about by addition of oxides of manganese was confined to alternate oxidation and deoxidation (like the decomposition of hydrogen peroxide in presence of the same substances). It is probable that the formation of potassium perchlorate during the decomposition of the pure chlorate by heat was due to an exothermic reaction independent of that which yielded chloride and oxygen. The non-production of perchlorate seemed to be the natural result of the addition of a substance (manganese dioxide) which brings about the transformation into chloride and oxygen at a temperature far below that at which the chlorate begins to give chloride and perchlorate.

Discussion.

Professor E. J. Mills said that, in association with Mr. Stevenson, he had, some years ago, investigated the action of manganic oxide on potassic chlorate. They had not been able to find or prepare an oxide free from constitutional water, and any attempt to render the oxide anhydrous resulted in a loss of oxygen. Eventually, they used the oxide of Beilstein and Javorsky. Their work had reference chiefly to the question of catalysis, and they found that small quantities acted in proportion more energetically than large ones. It should be borne in mind that the composition of hot manganic oxide was affected by pressure. Altogether, it was a question whether the numerous difficulties besetting the investigation could be satisfactorily surmounted.

Mr. SODEAU, in reply, stated that in his examinations of the aqueous extracts of the residues, phenolphthalein was employed with precautions against carbon dioxide, and a very small fraction of the amount of alkalinity found by Prof. McLeod would therefore have been detected. The extracts were actually slightly acid, and the residual manganese peroxide rapidly absorbed potash from solution.

*93. "Studies in the tetrahydronaphthalene series. I. The diazoamino-compounds of *ar*-tetrahydro-β-naphthalene." By C. Smith, B.Sc.

It has been shown by Bamberger and Bordt (*Ber.*, 1889, **22**, 625) that *ar*-tetrahydro-α-naphthylamine combines with diazonium salts, yielding azo-compounds.

The experiments of the author prove that *ar*-tetrahydro-β-naphthylamine behaves like a benzenoid amine and yields diazoamino-compounds.

The following compounds have been prepared and examined: p-*Toluenediazoaminotetrahydro-β-naphthalene*, $CH_3{\cdot}C_6H_4{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, yellow crystals, m. p. 107°; readily soluble in alcohol and benzene, sparingly in petroleum. o-*Nitrobenzenediazoaminotetrahydro-β-naphthalene*, $NO_2{\cdot}C_6H_4{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, orange-yellow crystals, m. p. 134°. p-*Nitrobenzenediazoaminotetrahydro-β-naphthalene*, $NO_2{\cdot}C_6H_4{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, well-defined chocolate-brown crystals, melting at 179° with violent decomposition. p-*Bromobenzenediazoaminotetrahydro-β-naphthalene*, $Br{\cdot}C_6H_4{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, crystallises in lemon-yellow needles which decompose slightly on exposure to the air and melt at 134°. *Diazoaminotetrahydro-β-naphthalene*, $C_{10}H_{11}{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, well-defined, amber coloured crystals; m. p. 104°. *β-Naphthalenediazoaminotetrahydro-β-naphthalene*, $C_{10}H_7{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_{11}$, crystallises in light yellow, lustrous plates, m. p. 137·5°. *Tetrahydro-β-naphthaleneazo-β-naphthylamine*, $C_{10}H_{11}{\cdot}N_2{\cdot}C_{10}H_6{\cdot}NH_2$, dark-red, lustrous crystals moderately soluble in hot alcohol; m. p. 130°. *Tetrahydro-β-naphthaleneazo-β-naphthol*, $C_{10}H_{11}{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH$, vermilion-red crystals with a green shimmer, m. p. 153°; it is insoluble in sodium hydroxide, and only sparingly soluble in hot alcohol.

Discussion.

Dr. Morgan pointed out that the mixed diazoamines of the tetrahydronaphthalene series are members of an extensive series of diazoamino-compounds having the general formula XN_3HY, which can be produced from one or other of the two pairs of generators, XN_2Cl,YNH_2 and YN_2Cl,XNH_2, where X and Y are dissimilar aromatic nuclei derived from benzene, naphthalene (*Trans.*, 1902, **81**, 90), and tetrahydronaphthalene.

The genesis of these substances and their decomposition with mineral acids justify the belief that they are solid solutions of the two compounds, $XN_2{\cdot}NHY$ and $YN_2{\cdot}NHX$.

*94. "Experiments on phosphorus tetroxide." By C. A. West, B.Sc.

The author gave an account of the preparation of phosphorus tetroxide and of his attempts to determine its molecular weight. Methods based upon observation of the freezing or boiling points of a solution could not be used, no suitable solvent being found. At a red heat, under atmospheric pressure, the compound does not volatilise rapidly enough to allow of the determination of vapour density, but four concordant experiments at about 1400° led to the unexpected conclusion that the molecular formula is P_8O_{16}, that is, twice what would have been expected from comparison with P_4O_6 and P_4O_{10}.

Some new determinations of the vapour density of phosphoric oxide at this temperature were also made. The mean of six concordant results gave 300·4 for the molecular weight, P_4O_{10} requiring 284.

95. "The decomposition of compounds of selenium and tellurium by moulds and its influence on the biological test for arsenic." By O. Rosenheim, Ph.D.

A paper has recently been published (Maassen, *Arb. Kais. Ges. A.*, 1902, **18**, 475) on the biological test for arsenic and the formation of organic compounds of arsenic, selenium, and tellurium by moulds. The author has been occupied for some time on the same subject in its connection with the detection of arsenic in beer and sugar, and had intended to publish his results in a more complete form. In view of Maassen's publication it has, however, been thought advisable to give a short *résumé* of the results in this direction confirming those of Maassen.

The biological test for arsenic (Gosio, *Ber.*, 1897, **30**, 1024) is said to be characteristic of this substance (Abel and Buttenberg, *Z. Hyg.*, 1899, **32**, 449). The test consists in the formation of gaseous organic arsenic compounds, possessing a characteristic garlic odour, produced by the vigorous growth of certain moulds (*Aspergillus*, *Mucor*, and *Penicillium*) in media containing arsenic, and permits of its detection where chemical methods fail. When applying this test to certain substances (beer and sugar) which contained selenium and arsenic, the author noticed a pronounced fæcal odour different from that produced by arsenic alone. It was thought that this was due to the presence of selenium, and experiments with soluble selenium compounds confirmed this view. It was also found that tellurium compounds were decomposed by *Penicillium brevicaule*, giving rise to the production of a very characteristic odour. Owing to the extreme sensitiveness of the test with regard to arsenic, it was thought necessary to employ absolutely pure compounds of selenium and tellurium. The odour produced by the decomposition of selenium compounds is of a very disagreeable character (somewhat like skatol or mercaptan), whilst the gases formed by tellurium compounds possess a pronounced garlic odour. The test is extremely sensitive: 0·01 mg. in 1 c.c. of liquid is easily demonstrated by a vigorous growth of the mould. Unlike arsenic, pure selenium and tellurium are not attacked by the mould. It was found best to perform the test by using the medium proposed by Abel and Buttenberg (*loc. cit.*), namely, sterilised bread-crumbs, to which the sterilised liquid in question is added after infection with the mould.

The author has drawn attention elsewhere (*Chem. News*, 1901, **83**, 277) to the influence of selenium on certain chemical tests for arsenic, and it is evident from the above results that in applying the biological test for arsenic, it is also necessary to take the possible presence of selenium (and tellurium) into consideration.

96. "Constituents of Gambier and Acacia catechus." By A. G. Perkin and E. Yoshitake.

The short paper on catechin, just published (Kostanecki and Tambor, *Ber.*, 1902, **35**, 1867), renders it necessary to give the results of an investigation which has been in progress for more than two years. The gambier catechu employed has been found to contain two catechins (*b*) and (*c*), and a third (*a*) has been isolated from the acacia catechu.

Catechin (*b*), $C_{15}H_{14}O_6,4H_2O$, air-dried, colourless needles, corresponds in its melting point, 175—177°, with Gautier's (*b*) catechin (*Bull.*, 1879, **30**, 567), and gives, on fusion with alkali, phloroglucinol, protocatechuic acid, and an acid resembling acetic acid. The *disazobenzene* compound (compare Etti, *Monats.*, 1881, **2**, 552), $C_{15}H_{12}O_6(C_6H_5N_2)_2$, salmon-red needles, m. p. 193—195°; its *triacetyl* derivative, $C_{15}H_9O_6(C_6H_5N_2)_2(C_2H_3O)_3$, orange-red needles, m. p. 253—255°;

pentabenzoyl catechin, $C_{15}H_7O_6(C_7H_5O)_5$, colourless needles, m. p. 151—153°, and *tetrabenzoyl* catechin, prismatic needles, m. p. 171—172°, have been studied. Molecular weight determinations by the cryoscopic method of the two latter compounds confirm these formulæ.

Catechin (*c*), $C_{15}H_{14}O_6$, air-dried, contains no water of crystallisation, and forms colourless prisms, m. p. 235—237°. It yields an *azobenzene* compound, $C_{15}H_{12}O_6(C_6H_5N_2)_2$, orange-red needles, m. p. 215—217°, the *acetyl* derivative of which melts at 250—253°, and on fusion with alkali gives phloroglucinol and protocatechuic acid. It has been found at present only in minute quantity.

Catechin (*a*), $C_{15}H_{14}O_6,3H_2O$ (or less probably $C_{14}H_{14}O_6,3H_2O$) air-dried, forms colourless needles and corresponds in its melting point, 204—205°, with Gautier's (*a*) catechin. Molecular weight determinations of the *pentabenzoyl* derivative (prismatic needles, m. p. 181—183°) coincide with this formula. The *azobenzene* compound, $C_{15}H_{12}O_6(C_6H_5N_2)_2$, needles, m. p. 198—200°, gives a *triacetyl* derivative, $C_{15}H_9O_6(C_6H_5N_2)_2(C_2H_3O)_3$, orange-red leaflets, m. p. 227—229°. Fusion with alkali gave phloroglucinol, protocatechuic acid, and an acid resembling acetic acid.

Cyanomaclurin (*Trans.*, 1895, **67**, 939), a constituent of *Artocarpus integrifolia*, has been found to contain a phloroglucinol group and is probably isomeric with these catechins.

97. "The decomposition of oxalacetic hydrazone in aqueous and acid solution, and a new method of determining the concentration of hydrogen ions in solution." By H. O. Jones and O. W. Richardson.

When oxalacetic hydrazone is heated with dilute acids it gives rise simultaneously to pyruvic hydrazone and carboxylic dioxide and to pyrazolone carboxylic acid and water (Fenton and Jones, *Trans.*, 1901, **79**, 92), the amounts of the former products being in the inverse order of the concentrations of the hydrogen ions in the solutions used. The hypothesis suggested to explain these observations was that the negative ion of the oxalacetic hydrazone underwent the first of the above decompositions when heated, whereas the undissociated molecule underwent the second.

Experiment shows that the results are better explained by supposing that the rate of decomposition into pyruvic hydrazone is proportional to the concentration of oxalacetic hydrazone, whereas the rate of formation of the pyrazolone carboxylic acid is jointly proportional to the concentration of the original substance and of the hydrogen ions.

The reaction was investigated in two ways, first the rate of evolution of carbon dioxide at a constant temperature (about 80°) was determined, and, secondly, the total amount of carbon dioxide given off at 100° was determined, in both cases water and sulphuric acid of different strengths being used. The results obtained agree with the requirements of the second hypothesis.

According to both theories, the amount of carbon dioxide produced satisfies the following equation, $\log\left[\dfrac{1}{1-\dfrac{C_2}{[C_2]_\infty}}\right]=\beta t$, where C_2 = concentration of pyruvic hydrazone (or amount of carbon dioxide evolved) at any time t, $[C_2]_\infty$ its final concentration, and β = a constant.

The hypothesis of the decomposition of the negative ion requires that β should decrease with increasing concentration of hydrogen ions, whereas the view here put forward requires that β should increase. Now it was found that β did increase with increasing concentration of hydrogen ions. This forms a crucial test between the two views.

A quick and easy method for determining the concentration of hydrogen ions in solution has also been worked out and tested.

Experiments have been made with the *p*-bromophenyl hydrazone of oxalacetic acid which decomposes in a similar way, and the results show satisfactory agreement with requirements of the theory stated above.

98. "The dissociation constants of oxalacetic acid and its hydrazone." By H. O. Jones and O. W. Richardson.

The authors have determined the dissociation constants of oxalacetic acid and its phenyl hydrazone. The conductivities of solutions of these substances were determined at 25°, and from the results the following values were obtained:

For oxalacetic acid, K = 1·33. Oxalacetic hydrazone, K = 0·11.

99. "Derivatives of butyrylpyruvic acid." By A. Lapworth and A. C. O. Hann.

Certain points of interest arising out of the study of the Claissen reaction as applied to $\alpha\beta$-unsaturated ketones (*Trans.*, 1901, **79**, 1283) led the authors to study the action of ethyl oxalate and sodium on benzylidene*iso*propylmethylketone. The results were not those anticipated, but the following compounds have been prepared in the course of the work:

*Benzylidene*iso*propylmethylketone*, $CHMe_2{\cdot}CO{\cdot}CH{:}CHPh$, is an oil (b. p. 274—276°). The *oxime* melts at 131—132° and the *semicarbazone* at 166—167°.

Ethyl iso*butyrylpyruvate*, $CHMe_2{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CO_2Et$, from *iso*propylmethylketone, ethyl oxalate, and sodium ethoxide, is a nearly colourless oil which boils and decomposes at 230—232°; it does not solidify at −15°. The *copper*, *nickel*, *calcium*, and other derivatives have been prepared. When the ester is hydrolysed with strong potassium hydroxide solution under certain conditions and the resulting solution treated with excess of strong hydrochloric acid, a sparingly soluble compound is precipitated in quadratic plates. This is an *acid potassium* iso*butyrylpyruvate* having the composition $(C_7H_{10}O_4)_3{\cdot}C_7H_9O_4K$; its solution gives a red coloration with ferric chloride, and becomes yellow on addition of excess of alkalis; it is only decomposed by a large excess of mineral acid; a similar sodium salt was not obtained.

Ethyl n-*butyrylpyruvate*, $Pr{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CO_2Et$, is similar in properties to the ester described above. When it is hydrolysed with potassium hydroxide, it yields a sparingly soluble *acid potassium* n-*butyrylpyruvate* crystallising in asbestos-like needles, which has, however, the composition $(C_7H_{10}O_4)_2{\cdot}C_7H_9O_4K$. As in the former instance, this substance is very stable towards acids, and no corresponding sodium salt could be obtained.

100. "Sulphocampholenecarboxylic acid." By A. W. Harvey and A. Lapworth.

When the residues obtained by evaporating the last aqueous mother liquors in the preparation of ammonium bromocamphorsulphonate were fractionally extracted with alcohol, a small quantity of a new substance dissolved and was obtained in the form of transparent, calcite-like crystals. A small quantity of this product has also been obtained by Dr. Kipping.

The compound has the formula $C_{10}H_{15}SO_5NH_4$, and it is the hydrogen ammonium salt of an unsaturated, monocyclic, sulphocarboxylic acid, $CO_2H{\cdot}C_9H_{14}{\cdot}SO_3H$, for which the name *sulphocampholenecarboxylic acid* is proposed. That it is unsaturated is shown by its aqueous solution instantly decolorising bromine water and an ice-cold solution of potassium permanganate.

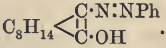
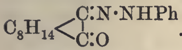
The normal *barium* and *calcium* salts, $C_{10}H_{15}SO_5Ba$ and $C_{10}H_{15}SO_5Ca$, crystallise well and are more soluble in cold than in hot water; the normal *ammonium* salt is very soluble in water. The *hydrogen barium* and *hydrogen calcium* salts crystallise in fine needles. The chloride and bromide do not crystallise readily.

When solutions of the salts are treated with bromine, a molecular proportion of the latter is at once absorbed, and a very sparingly soluble substance separates. This appears to be a sultonecarboxylic acid, $CO_2H{\cdot}\underline{C_9H_{14}Br{\cdot}SO_2{\cdot}O}$; it crystallises from chloroform in small prisms, melts and decomposes at 155°, dissolves in alkalis and alkali carbonates, and is reprecipitated unchanged by acids.

The investigation of the acid and its derivatives is in progress.

101. "Some properties of camphorquinonephenylhydrazone."

By A. Lapworth and A. C. O. Hann.

It has been found by Betti (*Ber.*, 1899, 32, 1995) that camphorquinonephenylhydrazone ("camphormethylenehydrazone") usually exists as a mixture of two desmotropic forms. One of these melts at 180°, gives a reddish coloration with ferric chloride in benzene solution, and is therefore probably the enolic form,  $C_8H_{14}<\begin{matrix}C\cdot N:NPh\\ \| \\ C\cdot OH\end{matrix}$. The other, melting at 155°, may be isolated by adding a trace of piperidine to a solution of the hydrazone in benzene; as it gave no distinct colour with ferric chloride, it was supposed to be the ketonic form,  $C_8H_{14}<\begin{matrix}C:N\cdot NHPh\\ | \\ C:O\end{matrix}$.

With Betti's permission, the authors have carefully studied the properties of the compound, and, although they are able to confirm all his statements with regard to the enolic form, they have not been able to isolate a second modification in the pure state, although there can be no doubt that one is present; they think that the substance melting at 155° must be a mixture of both forms.

The speed with which equilibrium between the two forms, in various media, is attained was investigated by observations of the mutarotation. Equilibrium appears to be reached most rapidly in alcoholic solution, a constant rotation being observed at once. In chloroform or benzene, however, the change occurs very slowly, as in 1 per cent. solution at the ordinary temperature it occupies several days.

In benzene, with solutions varying in concentration from 0·1 to 1 per cent., the initial rotation, when the pure enol is used, is about $[\alpha]_D = +325°$, and falls to between +205° and 290° according to the concentration. With all specimens of mixed material, even when prepared by Betti's method, a fall was invariably observed in dilute solution, indicating that the enol was still present in considerable amount.

The effect of catalytic agents on the rate of change in benzene was carefully studied. Traces of bases, if not too weak, whether primary, secondary, or tertiary, accelerate the change, and, amongst others, ammonia, aniline, piperidine, pyridine, brucine, and strychnine were tried and found to be effective. Acids, on the other hand, retard the change, and it is possible to arrest the fall in rotation at any point desired by the addition of a minute quantity of trichloroacetic acid, when it will again proceed on addition of a trace of a base.

In all cases, as was to be expected, the state of equilibrium was found to be independent of the catalytic agent.

102. "Optically active esters of β-ketonic and β-aldehydic acids. Part I. Menthyl hydroxymethylenephenylacetate." By A. Lapworth and A. C. O. Hann.

The authors propose to investigate certain aspects of the question of tautomerism involving the migration of hydrogen atoms by the employment of esters of β-ketonic and β-aldehydic acids with optically active alcohols of high molecular weight. It is hoped that the compounds may thus be obtained in a crystalline and, therefore, more easily purified form, and that by observation of the change of rotation, further evidence with regard to certain obscure points may be obtained.

Menthyl hydroxymethylenephenylacetate, $HO\cdot C\colon CPh\cdot CO_2C_{10}H_{19}$, may be prepared by the action of sodium on a mixture of menthyl phenylacetate and formate dissolved in anhydrous ether. It is precipitated from the aqueous solution of its sodium derivative on addition of acids as an oil which rapidly soldifies, and crystallises from light petroleum in transparent prisms or pyramids, which belong to the tetragonal system. These melt at 82—83° and exhibit triboluminescence, which is sufficiently brilliant to be observed in broad daylight. Its freshly prepared 2 per cent. solution in chloroform has $[\alpha]_D = -74\cdot6°$; this falls in a few days to about $-71°$. In absolute alcohol, the rotation is $[\alpha]_D = -64\cdot9°$, and falls only slightly, if at all, in course of time. Although its alcoholic solution is rapidly coloured violet by ferric chloride, its solution in ether or benzene is not affected unless it is boiled with the salt for some time, or a trace of a base is added, when a similar coloration develops. The solid probably represents the aldehydic form of the ester (Wislicenus, *Ann.*, 1900, 312, 34).

The *copper* derivative crystallises in green prisms which melt and decompose at 92—95°; the *sodium* derivative forms thin, transparent plates.

The *phenylcarbamate*, $NHPh\cdot CO_2\cdot CH\colon CPh\cdot CO_2\cdot C_{10}H_{19}$, crystallises in long, slender needles melting and decomposing at 235—237°. The *acetate*, $AcO\cdot CH\colon CPh\cdot CO_2\cdot C_{10}H_{19}$, separates from ethyl acetate in needles melting at 51—52°.

The oxime is immediately precipitated as an oil on mixing solutions of the ester with one of free hydroxylamine or hydroxylamine acetate. With phenylhydrazine, the ester is converted into the diphenylpyrazolone which is obtained from the corresponding ethyl ester.

The enolic modification of the ester appears to be very unstable, and under conditions in which the liquid enolic ethyl ester may be obtained, the above compound was always produced. No evidence of the existence of isomeric copper or acetyl derivatives could be obtained.

103. "Optically active esters of β-ketonic and β-aldehydic acids Part II. Menthyl acetoacetate." By A. Lapworth and A. C. O. Hann.

Menthyl acetoacetate may be obtained in small quantity by the action of sodium on menthyl acetate, but is far more easily prepared by heating menthol with ethyl acetoacetate until alcohol ceases to come off. These observations were made before the authors were aware that Cohn had prepared the ester by the latter process (*Monatsh.*, 1900, **21**, 200—204). As Cohn has since notified (*Ber.*, 1900, **33**, 734) that he had abandoned the work, with his concurrence the authors have resumed the study of this substance and its derivatives.

The compound may be obtained in large, lustrous, probably monoclinic prisms which the authors believe to represent the ketonic form. Its rotation in 2 per cent. solution in benzene is initially about $[\alpha]_D = -61—62°$ but slowly increases to about $-68°$, owing doubtless to partial conversion into the enolic form; similar changes are observed when it is dissolved in chloroform, light petroleum, and dry ethyl acetate. The duration of the change varies greatly with the purity of the solvent, as the compound is exceedingly sensitive to catalytic agents. As usual, all bases accelerate the change, and the mutarotation, unlike that of camphorquinonehydrazone, and of nitrocamphor is accelerated by traces of acids also. Equilibrium between the two forms appears to be attained almost at once in alcohol, practically no alteration of rotation with time being noticeable.

The *copper* derivative of the ester crystallises from alcohol in green prisms which contain alcohol; these rapidly become opaque and finally have the melting point 117—118°.

The ester readily affords a well-defined *semicarbazide*, $NH_2 \cdot CO \cdot N_2H_2 \cdot CMe\colon CH \cdot CO_2C_{10}H_{19}$, flat needles, m. p. 143—144°; in benzene $[\alpha]_D = -56 \cdot 1°$. The p-*nitrophenylhydrazide*, $C_6H_4NO_2 \cdot N_2H_2 \cdot CMe\colon CH \cdot CO_2 \cdot C_{10}H_{19}$, brilliant prisms, m. p. 105—106°; in benzene $[\alpha]_D = -42 \cdot 5°$.

Menthyl β-aminocrotonate, $NH_2 \cdot CMe\colon CH \cdot CO_2C_{10}H_{19}$, prepared by the action of gaseous ammonia; forms large, transparent plates, m. p. 88—89°; in benzene $[\alpha]_D = -105 \cdot 2°$. *Menthyl β-phenylaminocrotonate* $NHPh \cdot CMe\colon CH \cdot CO_2C_{10}H_{19}$, crystallises in flat, rectangular plates m. p. 85—86°; it has $[\alpha]_D = -98 \cdot 2°$. *Menthyl benzylaminocrotonate*, $CH_2Ph \cdot NH\colon CMe\colon CH \cdot CO_2C_{10}H_{19}$, crystallises in flat needles, m. p. 85—86°; in benzene $[\alpha]_D = -59 \cdot 8°$.

Menthyl C-benzoylacetoacetate, $CHBzAc \cdot CO_2C_{10}H_{19}$, is an oil; in benzene $[\alpha]_D = -44 \cdot 3°$; its *copper* derivative forms slender needles, is sparingly soluble in most media, and melts at about 230°.

Neither the oxime, the *iso*nitroso-, nor bromo-derivatives of the ester have yet been obtained in a pure condition.

The ester condenses readily with aldehydes, forming, in some cases, well crystallised compounds. Unlike ethyl acetoacetate, when condensed with benzaldehyde at the ordinary temperature by the aid of piperidine, it affords, for the most part, a monobenzylidene compound.

104. "The mechanism of simple desmotropic change." By A. Lapworth and A. C. O. Hann.

Brühl has advanced the hypothesis (*Ber.*, 1899, **32**, 2329) that enols (which are weak acids and electrolytes) are transformed into the isodynamic ketones, by a process which involves initial ionisation into hydrogen ions and organic ions or "residues," which may reunite in two ways, so that finally the ketone is produced in this manner :

$$:C{=}C{\cdot}OH \longleftrightarrow :C{=}\overset{-}{C}{-}O+\overset{+}{H} \longrightarrow :CH{-}\dot{C}{=}O.$$

He found, as he anticipated, that the velocity of transformation of enolic ethyl mesityloxideoxalate in solution into the ketonic form increases roughly with the dielectric constant of the medium.

Although the principle here introduced appears quite reasonable, and more capable of experimental and theoretical development than any other yet suggested, it is clearly incomplete, since ketones, although apparently non-conductors, are known to exist in equilibrium with their conducting enolic forms, and the velocity of transformation must be far slower than the ionisation velocity. Since change of internal structure is necessary, and isomerisation appears to increase with ionisation, the authors think that Brühl's suggestion would lead to the following view of the processes involved in a keto-enol transformation (compare *Trans.*, 1901, **79**, 1266).

$$\left\{\begin{array}{rcl} X{=}Y{-}Z{-}H & \longleftrightarrow & X{=}Y{-}Z{-}\;+H \\ X{=}Y{-}Z{-} & \longleftrightarrow & -X{-}Y{=}Z \\ -X{-}Y{=}Z+H & \longleftrightarrow & XH{-}Y{=}Z \end{array}\right.$$

Here it appears necessary to assume that ketones themselves are very slightly ionised, which is consistent with the views of Thiele, Vorländer, and others. According to this view, bases should accelerate and acids retard the change, and the state of equilibrium should be independent of the catalytic agent, but dependent, not only on the two dissociation constants, but also on the velocities indicated in the second line. It is, in fact, perfectly consistent with the properties of certain isodynamic pairs, for example, nitro- and *iso*nitro-camphor (Lowry, *Trans.*, 1899, **75**, 221), and camphorquinonehydrazone.

However, the complete difference in behaviour of camphorquinonehydrazone and menthyl acetoacetate toward acids indicates that there are at least two classes of substances, and that more than one type of process may go on.

To account for the action of acids in accelerating the speed of migration of a hydrogen atom, in certain cases, on a principle similar to that proposed by Brühl, it seems necessary to assume that the compounds may react as bases. Since, as before, a change of structure is involved, the change may be conventionally analysed as follows:

$$\begin{array}{lcl} X=Y-Z-H+H & \longleftrightarrow & XH\underset{\cdot}{-}Y-Z-H \\ XH\underset{\cdot}{-}Y-Z-H & \longleftrightarrow & XH-Y\underset{\cdot}{-}Z-H \\ XH-Y\underset{\cdot}{-}Z-H & \longleftrightarrow & XH-Y=Z+H \end{array}$$

where the dot indicates the direction in which the "free affinity" of *Y* is temporarily disposed, a convention easily understood by reference to models.

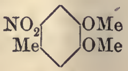
The process thus represented requires an acceleration of the change by acids, and a final state of equilibrium independent of their presence.

Clearly, a compound might react in either or possibly in both ways, according to the conditions. In nearly all cases observed, however, the first process would appear to go on, the latter being somewhat exceptional, at least as an important factor. Obviously, the state of equilibrium must be the same when attained by either process.

105. "Trimethylbrazilone." By W. H. Perkin, jun.

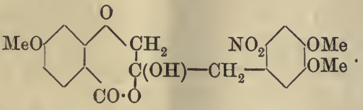
During the course of a long series of experiments on the constitution of brazilin, it was shown (W. H. Perkin and A. W. Gilbody, *Proc.*, 1899, 15, 27) that trimethylbrazilin, $HO{\cdot}C_{16}H_{10}O(OMe)_3$, on oxidation with chromic acid, yields trimethylbrazilone, $HO{\cdot}C_{16}H_8O_2(OMe)_3$. It was also stated that nitric acid converts trimethylbrazilone into a substance crystallising in yellow needles, which dissolve in alkalis, forming an intense purple solution; this, on standing, yields besides *p*-methoxysalicylic acid, $MeO{\cdot}C_6H_3(OH){\cdot}CO_2H$, two neutral substances melting at 118° and 206° respectively. Since the yellow substance did not give the usual qualitative tests for nitrogen, it was at first thought that it did not contain this element; subsequent quantitative experiments, however, demonstrated the presence of nitrogen, and showed that the substance has the formula $C_{19}H_{19}O_9N$. It is proposed to name it *nitrohydroxydihydrotrimethylbrazilone.*

The two neutral substances having the melting points 118° and 206° are probably isomeric, and have the formula $C_9H_{11}O_4N$, and as they each contain two methoxy-groups, they are apparently nitrodimethoxymethylbenzenes, the former (m. p. 118°) being probably identical with the compound



which has already been prepared by H. Cousin (*Ann. Chim. Phys.*, 1898, [vii], **13**, 480), and which melts at 117°. There is, however, a possibility that the very sparingly soluble substance of melting point 206° has a higher molecular weight such as that represented by the formula $(C_9H_{10}NO_4)_2$.

When nitrohydroxydihydrotrimethylbrazilone is oxidised with permanganate, it yields 2-carboxy-5-methoxyphenoxyacetic acid, and since it also yields an acetyl compound, it is probably a lactone, having the formula



or some formula closely allied to it.

The author has not yet concluded his experiments on this interesting nitro-compound, but finds it necessary to publish this short note because of a recent publication of Bollina, Kostanecki, and Tambor (*Ber.*, 1902, **35**, 1675), which contains a description of some experiments on this compound.

The author hopes that these chemists will allow him, for a short time longer, the uninterrupted investigation of this substance.

At the next meeting, on **Wednesday**, June 18th, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Elimination of a nitro-group on diazotisation. Dinitro-*p*-anisidine." By R. Meldola and J. V. Eyre.

"A new type of substituted nitrogen chlorides." By F. D. Chattaway.

"The colour-changes exhibited by the chlorides of cobalt and some other metals, from the standpoint of the theory of electro-affinity." By F. G. Donnan and H. Bassett, jun.

"The stereochemical formulæ of benzene." By J. E. Marsh.

"An accurate method of determining the compressibility of vapours." By B. D. Steele.

"The molecular condition of borax in solution." By H. S. Shelton.

"Preliminary notice of some new derivatives of pinene and other terpenes." By W. A. Tilden and H. Burrows.

"The preparation of pure chlorine and its behaviour towards hydrogen." By J. W. Mellor and E. J. Russell.

"The union of hydrogen and chlorine. Part V." By J. W. Mellor.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on **Wednesday, June 18th,** 1902.

Ball, James Handby,

St. Stephen's Villa, Limerick.

Analytical Chemist. B.Sc. Honours Chemistry, Victoria University. Analyst to The Condensed Milk Company of Ireland, Ltd. Past Experience. (1) Assistant to Dr. Campbell Brown. (2) Chemist to The North of England Chemical Works, Berwick-upon-Tweed. (3) Science Master of The Carpenters' Company's Technical Institute, Stratford, E., and at The Blue School, Wells, Somerset.

J. Campbell Brown. Herbert B. Stocks.
W. Collingwood Williams. Charles A. Kohn.
J. G. Taylor.

Bucknell, Edwin Thomas Holman,

Ebley House, Parsonage Street, Dursley, Glos.

Chemical Laboratory Assistant. Student in the Merchant Venturers' Technical College Laboratory (Bristol) three years. Five and a half years as Assistant in the Rugby School Chemical Laboratory.

G. Stallard. James Leicester.
J. Wertheimer. F. N. A. Fleischmann.
G. P. Darnell-Smith.

Burt, Bryce Chudleigh,

University Settlement, Bermondsey, S.E.. ; Univ. Coll., Gower Street.

Research Student at University College. B.Sc. (Lond.), first class hon. Chemistry. Late Student and Associate of Merchant Venturers' Coll. Bristol (four years). At present Research Student at Univ. College, London.

William Ramsay. F. G. Donnan.
Edward C. Cyril Baly. Morris W. Travers.
Alex. Findlay.

Claudet, Arthur Crozier,

27, Daleham Gardens, Hampstead, N.W.

Assayer and Metallurgist, and Analytical Chemist. Associate of the Royal School of Mines. Fellow of the Institute of Chemistry.

W. C. Roberts-Austen. John S. Sellon.
Thos. Kirke Rose. George Matthey.
A. K. Huntington.

Clough, William Thomas,

3, Watford Villas, Battersea Park, S.W.

Science Master, Owens School, Islington. Science Lecturer, City of London College. A.R.C.S. (London); 1st Honours in Chemistry, South Kensington Exams.; Fellow of the Physical Society of London; Late National Scholar.

William A. Tilden. W. H. C. Jemmett.
W. Palmer Wynne. A. E. Dunstan.
Chapman Jones. *James C. Philip.*
M. O. Forster.

Davis, Henry Wilson,

18, Crescent Road, Kingston Hill, Surrey.

Analyst, Government Laboratory. First Class Certificate School of Mines, Theoretical and Practical Chemistry. Thirty years' experience in analytical work in Government Laboratory, London.

T. E. Thorpe. C. H. Burge.
H. J. Helm. J. Woodward.
Edwd. Jones. C. Proctor.

Ferris, Percy J.,

Heathfield, Seymour Grove, Old Trafford, Manchester.

Chemist in firm of Chemical Brokers, Liverpool. For 3 years student in Chemical Laboratories of the Owens College. For 1 year research student under Prof. W. H. Perkin.

H. B. Dixon. J. Campbell Brown.
W. H Perkin, jun. Arthur Smithells.
J. Norman Collie.

Foll, Edgar William,

40, Sutton Street, Lambeth, S.E.

Brewer. Engaged at Lion Brewery, Belvedere Road, S.E. Have studied chemistry for a considerable period. During the past four years have been under the tuition of Matthew J. Cannon studying chemistry in relation to brewing. Obtained prize medal in brewing, 1899; silver medal honours, 1900, City and Guilds Examination. Have assisted Mr. Cannon in investigation work. Desire to join the Society to keep in touch with scientific progress.

Matthew J. Cannon. *C. A. Mitchell.*
M. Cannon. *Arthur R. Ling.*
J. Jackson. *Arthur Hartley.*

Francis, Francis E.,

8, Manilla Road, Clifton, Bristol.

Lecturer and Demonstrator in Chemistry, University College, Bristol. B.Sc. (Victoria); Ph.D. (Erlangen); A.I.C., 1892; Assistant Lecturer in Chemistry at Univ. Coll., Liverpool, 1895. Senior Lecturer and Demonstrator, Univ. Coll., Bristol, since 1896. Author of "Zur Kenntniss der *o*-Amidobenzylamine"; "The Dinitrosamines of Ethylenaniline and its Derivatives"; "The Separation of *N*- and *iso*-Heptane from American Petroleum"; "Action of Fuming Nitric Acid on Paraffins and other Hydrocarbons"; "Derivatives of Dibenzyl Ketone."

Sydney Young. Philip J. Worsley.
W. A. Shenstone. J. Campbell Brown.
W. Collingwood Williams.

Garle, John Longsdon,

136, Holland Road, Kensington, W.

Consulting Chemist. Student at University College, London.

Demonstrator at Pharmaceutical Society. Assistant to Charles J. Wilson, Esq. I am desirous of attending the meetings of the Society and obtaining its publications.

J. Norman Collie. Edward C. Cyril Baly.
William Ramsay. F. G. Donnan.
Charles J. Wilson.

Gow, Alexander,

38, Clarendon Street, Cambridge.

Student. Lecturer in Chemistry. Borough Road Training College, 1893–97. Chief Science Master, County High School, Isleworth. Isleworth, 1897–1900. B.Sc., London, 1893, in Chemistry. Studying Chemistry at Cambridge under Dr. Ruhemann.

S. Ruhemann. R. S. Morrell.
M. M. Pattison Muir. Hugh Ramage.
H. O. Jones.

Hallowell, Thomas Butterworth,

Ladyshawe House, New Mills, Derbyshire.

Analytical Chemist to Calico Printing Works, Birch Vale, Derbyshire. Having studied Chemistry at the Owens College, and been Assistant for five and a half years to A. W. Duncan, Esq., F.C.S., in the Analytical Laboratory of Messrs. J. Woolley, Ltd., Manufacturing Chemists, Manchester. Have held my present position for nearly two years.

Arthur W. Duncan. W. T. Lawrence.
Wm. A. Bone. J. F. Thorpe.
H. B. Dixon.

Hann, Archie Cecil Osborn,

54, Wood Vale, Forest Hill, S.E.

Teacher of Chemistry. For four years Student in the Chemical Dept., Goldsmiths' Technical Institute, New Cross. Now Assistant Lecturer in the same. Engaged on Research Work with Dr. Arthur Lapworth.

Arthur Lapworth. Stanley J. Peachey.
Alfred W. Harvey. Gerald T. Moody.
William J. Pope. Arthur H. Coote.

Harrison, Walter Ernest,

43, Mostyn Road, Handsworth, Staffs.

Science Master, Technical School, Handsworth. Associate of the Royal College of Science, London. Eight years Senior Science Master, Addey and Stanhope School, S.E. Now Science Master, Handsworth Technical School, Staffs.

Wm. Ping.	J. W. Shepherd.
J. H. Wolfenden.	*Chas. Wood.*
T. A. Cheetham.	*Chapman Jones.*
S. Whalley.	*James C. Philip.*
S. Parrish.	*Alex. W. Bain.*

Leader, George Herbert,

Sexey's School, Blackford, Wedmore, Somerset.

Senior Science Master at Sexey's Secondary and Technical School. A Student, during 1898, in the Chemical Laboratory of the Merchant Venturers' Technical College, Bristol. Chemical Laboratory of University College, Bristol, 1899—1900, and the Chemical Laboratory of University College, London, 1901. B.Sc. Lond. (with Honours in Chemistry and Zoology), 1901. Associate of University College, Bristol.

Sydney Young.	F. G. Donnan.
J. Wertheimer.	Edward C. Cyril Baly.
William Ramsay.	Morris W. Travers.

Lessner, Charles B.,

Fonda de Porto, Carril, Spain.

Metallurgical Chemist and Assayer. Studied Chemistry and Metallurgy at Battersea, Chelsea, and Woolwich Polytechnics, Northampton Institute, Birkbeck Institution, King's College, &c. Student Institution Mining and Metallurgy. Two years Assistant to Messrs. Holloway, Lake, and Currie. Assayer to the Kai Syndicate, Gold Coast Colony.

George T. Holloway.	Herbert S. Wallace.
Philip Schidrowitz.	Alec. A. Beadle.
C. J. Head.	John Wilson.

Moody, James Butler,

111, Manchester Road, Burnley, Lancs.

Head Brewer at Massey's Burnley Brewery Ltd., Burnley, Lancs.

Formerly student under Dr. Graham and Mr. Alfred C. Chapman, of London, and Dr. Miller, of Manchester.

Alex. K. Miller. Alfred Chapman.
John F. Rolfe. Tom Crossman.
Fred R. Stone.

Moore, Thomas Henry,
19, Sandmere Road, Clapham, S.W.

Chemist. Major Exam. of the Pharmaceutical Society.

W. Watson Will. *Frederick B. Power.*
Harold C. Sayer. *F. Filmer De Morgan.*
J. Bernard Coleman. *E. F. Harrison.*

O'Connor, Sinnott Valentine,
14, Selskar Street, Wexford.

Pharmaceutical and Analytical Chemist. A Licentiate of the Pharmaceutical Society by Examination.

Charles R. C. Tichborne. J. Armstedt Ray, jun.
Henry Boyers. *John Barclay.*
Thomas Tyrer.

Phillips, Percy Philip, Ph.D.
Haslemere, Morris Avenue, Manor Park, E.

Chemist. Certificate of the City and Guilds of London Institute in Applied Chemistry. Ph.D. Göttingen. Researches published: (1) "Amidoamidines of the Naphthalene Series," with Prof. Meldola (2) "Beiträge zur Kenntnis der D-d-Fenchenderivate und der Fenchocarbonsäure," with Professor Wallach.

Raphael Meldola. M. O. Forster.
G. T. Morgan. *James C. Philip.*
William Robertson.

Pollitt, George Paton, Ph.D.,
St. Silas's Road, Blackburn, Lancashire.

I have studied Chemistry at Owens College, Manchester, and at the Polytechnicum of Zurich under Professor Lunge. I have obtained the degree of Bachelor of Science, Hons. Chemistry of the Victoria University and that of Doctor of Philosophy of the University of Bâle, my Dissertation for which latter degree, "On the use of Oxide of Iron as Contact Substance in the manufacture of Sulphuric Anhydride from Sulphur Dioxide and Air," will shortly be published.

Harold B. Dixon. D. L. Chapman.
W. H. Perkin, jun. Wyndham R. Dunstan.
J. F. Thorpe. G. Lunge.

Powney, William E. F.,

67, Barretts Grove, Stoke Newington, London, N.

Analytical Chemist and Assayer; Chief Assistant to Geo. T. Holloway, Esq., Consulting Chemist and Metallurgist, of 57, Chancery Lane, London, W.C. Studied Chemistry for three years under Prof. Meldola, F.R.S., at Finsbury Technical College, Leonard Street, City Road, E.C. Have held present position for nearly six years. Qualified to teach Chemistry and Metallurgy under the Board of Education. Member of the Society of Public Analysts, and of the Society of Chemical Industry. Student-member of the Institution of Mining and Metallurgy.

George T. Holloway. Alec. A. Beadle.
Philip Schidrowitz. D. A. Louis.
Raphael Meldola.

Ralph, Stephen Jamieson,

22, Stanley Place, Eccleston Square, S.W.

Assistant Research Chemist. Certificated Student, Technical College, Finsbury. Research Assistant, Imperial Institute, Scientific Department.

Raphael Meldola. Ernest Goulding.
F. Southerden. Henry H. Robinson.
J. Vargas Eyre. Thomas A. Henry.
E. H. Miller.

Ralphs, Edwin,

Hongkong.

Senior Grade Master, Queen's College, Hongkong (Hongkong Civil Service). Student in Chemistry since 1885. First Class Advanced Certificates in Inorganic Chemistry (Theor. and Pract.), also First Advanced Certificates in Organic Chemistry (Theor. and Pract.), Science and Art Dept. Desire to keep in touch with Chemical Progress.

Charles A. Fogg. T. M. Nightingale.
A. L. Thornton. Walter Ratcliffe.
Harold Rostron. *Jno. L. Whiteside.*

Rây, Prafulla Chandra,

Calcutta.

D.Sc. (Edin.). Chemical Laboratory, Presidency College. Has been for a long time Assistant to the Professor of Chemistry in the Presidency College, Calcutta. Is the author of several papers, principally upon the Nitrites of Mercury, which have appeared in the *Transactions*, *Zeit.*, *anorg. Chem.*, *Annalen*, and Calcutta journals.

Alex. Crum Brown. James Walker.
J. Gibson. William Ramsay.
Edward Divers.

Roast, Harold James,
3, Manor Park Road, Harlesden, N.W.

Student of Chemistry three years. Engaged in Analytical work, and Assaying. Desire Membership of the Society as I wish to attend the meetings and to have the Society's Journal.

Isaac Sydney Scarf. John Grove Johnson.
Harold W. Harrie. Charles A. West.
H. Y. Loram.

Skertchly, William Pearson,
The Laboratory, 11, Billiter Square, E.C.

Analytical Chemist. Fellow of the Institute of Chemistry of Great Britain and Ireland, Member of the Society of Chemical Industry and of the Society of Public Analysts. Contributor of original papers to *The Analyst.* Eleven years Chief Assistant to Mr. Otto Hehner, F.I.C., F.C.S.

Otto Hehner. Bernard Dyer.
Alfred C. Chapman. Arthur R. Ling.
B. E. R. Newlands.

Stanger, William C. S.,
72, Belle Vue Road, Ipswich.

Schoolmaster, Higher Grade School, Ipswich. Student in Chemistry 1892—1895; Durham College of Science under Dr. Bedson, Prof. of Chemistry, A.Sc. (Durham) in Chemistry and Physics (1894). In sole charge of Chemical Dept., Ipswich Higher Grade School. Have now under instruction approx. 500 pupils in Chemistry per week.

P. Phillips Bedson. *S. Hoare Collins.*
F. C. Garrett. *E. J. Cox.*
Duncan T. Richards. *R. L. Taylor.*
W. J. Stainer.

Stewart, Hector,

479, Collins Street, Melbourne.

Mining Engineer and Metallurgical Chemist (M.C.E.). Master of Civil Engineering, Melb. Univ. Twelve months in charge of works for the treatment of gold ores, including chlorination, concentration, and assaying, Victoria. Four years assayer in charge of laboratory of the Lyell Tharsis M. Co., Tasmania, engaged on ore, rock, slag, and other analyses and assays. Memb. Austrn. Inst. of Mining Engineers.

H. W. Potts. R. Dubois.
Henry C. Jenkins. *A. W. Craig.*
J. Dennant.

Wells, John William,

Springburn, Blackburn.

Medical Practitioner. M.B., C.M. Edinburgh, 1887. D.P.H. (Victoria) 1901. Am engaged on experiments on the relation between chemical constitution of fats and their digestibility, and desire Chemical Society's publications.

Robert H. Pickard. Jas. F. Burnett.
Harold B. Dixon. William Lewins.
William Carter. *Arthur Clegg Bowdler.*
W. H. Duckworth. *Francis V. Darbishire.*

West, Joseph,

50, Poplar Grove, Fenton, Stoke-on-Trent.

Analytical Chemist. Analytical and Consulting Chemist to the Stafford Coal, Iron, and Chemical Works. Formerly of the Darwen and Mostyn Iron Works, Darwen. Lancashire and Cheshire 1st prize in Honours Chem. S.K. Formerly Student at Blackburn T. Schl. and Darwen T. Schl.

C. Gerland. George George.
G. W. Burman. *Harry W. Dixon.*
Geo. P. Rees.

Wheeler, Edward J.

Albany, State of New York.

Analytical and Consulting Chemist. Has taught chemistry since 1888 at different times at Williams College, at Union University, in departments of Medicine and Pharmacy. As Analyst in employ since 1891 of State of N.Y. Board of Health and Department of Agriculture, N.Y.

John A. Miller. Joseph F. Geisler.
Willis G. Tucker. E. G. Love.
J. H. Wainwright.

The following certificate was authorised by Council under Bye-law I. (3):

Purtan, Herbert,
London Chambers, Durban.

Public Analyst for Borough of Durban. Studied at Aberdeen University. Teacher of Chemistry at Seamen's Hospital, Greenwich. Assistant to R. H. Davies. F.I.C., &c., Apothecaries' Hall. Managing Director, Natal Chemical Co.

W. H. Pay.	T. G. Macdonald.
J. S. Jamieson.	*A. Pardy.*

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 25/6/02

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 254.

Wednesday, June 18th, 1902. Professor Emerson Reynolds, Sc.D., V.P.R.S., President, in the Chair.

Messrs. Russell, Lattey, Ionides, Haas, and Heaton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Guy Dunstan Ricketts, Sir John Cass Technical Institute, E.C.
Edgar Stansfield, B.Sc., Technical College, Sunderland.
Thomas Edward Wallis, 78, Essex Road, Islington, N.

The President announced that the Council that afternoon had decided that the Ordinary Meetings of the Society for the ensuing session should be held, as far as possible, alternately, on Wednesdays at 5.30 p.m. and Thursdays at 8 p.m.

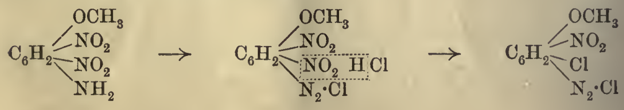
A Ballot for the Election of Fellows was held, and the following were subsequently declared duly elected:

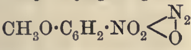
James Handby Ball, B.Sc.
Edwin Thomas Holman Bucknell.
Bryce Chudleigh Burt, B.Sc.
Arthur Crozier Claudet.
William Thomas Clough.
Henry Wilson Davis.
Percy J. Ferris.
Edgar William Foll.
Francis E. Francis, B.Sc., Ph.D.
John Longsdon Garle.
Alexander Gow, B.Sc.
Thomas B. Hallowell.
Archie Cecil Osborn Hann.
Walter Ernest Harrison.
George Herbert Leader, B.Sc.
Charles B. Lessner.
James Butler Moody.
Thomas Henry Moore.
Sinnott Valentine O'Connor.
Percy Philip Phillips, Ph.D.
George Paton Pollitt, Ph.D.
William E. F. Powney.
Herbert Purtan.
Stephen Jamieson Ralph.
Edwin Ralphs.
Prafulla Chandra Rây, D.Sc.
Harold James Roast.
William Pearson Skertchly.
William C. S. Stanger.
Hector Stewart.
John William Wells.
Joseph West.
Edward J. Wheeler.

Of the following papers, those marked * were read:

*106. "Elimination of a nitro-group on diazotisation. Dinitro-*p*-anisidine." By R. Meldola and J. V. Eyre.

Dinitro-*p*-anisidine, obtained by nitrating acet-*p*-anisidide and hydrolysing the acetyl derivative, was shown by the authors to have the constitution $C_6H_2NO_2{\cdot}NO_2{\cdot}NH_2{\cdot}OCH_3 = 2:3:4:1$. This compound, on diazotisation in acetic acid in presence of sulphuric or nitric acid, behaves normally and forms a dinitrodiazonium salt, which on heating with alcohol gives dinitroanisole, $C_6H_3{\cdot}NO_2{\cdot}NO_2{\cdot}OCH_3 = 2:3:1$, of m. p. 119°. The dinitrodiazonium salts combine with alkaline β-naphthol in the ordinary way to form the azo-compound, $CH_3O{\cdot}C_6H_2(NO_2)_2{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH\beta$. When diazotised in the presence of hydrochloric or acetic acid, one of the nitro-groups is eliminated as in the case of dinitro-*o*-anisidine (*Trans.*, 1900, **77**, 1172; *Proc.*, 1901, **17**, 131; *Trans.*, 1901, **79**, 1076). The authors showed that it is the 3-nitro-group, that is, the group which is *ortho* with respect to the diazonium group, which is thus eliminated. The product, when hydrochloric acid is used, contains chlorine in place of the 3-nitro-group, and is formed according to the scheme:



No diazoxide appears to be formed in this case, but the replacement of the nitro-group by chlorine takes place at once at the ordinary temperature. The chloronitrodiazonium salt, when boiled with alcohol, with or without the addition of alkali, gives chloronitroanisole, $C_6H_3\cdot Cl\cdot NO_2\cdot OCH_3 = 3:2:1$. The same diazonium salt, on combination with alkaline β-naphthol, gives the azo-compound, $CH_3O\cdot C_6H_2Cl\cdot NO_2\cdot N_2\cdot C_{10}H_6\cdot OH\beta$. When diazotised in the presence of acetic acid alone, the NO_2 group is replaced by hydroxyl, and the diazonium salt combines with β-naphthol to form the hydroxyazo-compound, $CH_3O\cdot C_6H_2\cdot NO_2\cdot OH\cdot N_2\cdot C_{10}H_6\cdot OH\beta$. In this case, a diazoxide,  $CH_3O\cdot C_6H_2\cdot NO_2{<}\overset{N_2}{\underset{O}{|}}$, may be formed as an intermediate product, but this has not yet been isolated.

The displacing of the nitro-group in the two dinitroanisidines now investigated tends to show that the elimination of this group follows the ortho-para law, and experiments for the purpose of testing this conclusion will be undertaken in due course.

*107. "Preliminary notice of some new derivatives of pinene and other terpenes." By W. A. Tilden and H. Burrows.

Pinene nitrosochloride is remarkable as being the only known compound containing the elements of pinene from which that hydrocarbon may be regenerated. The addition of one molecule of hydrogen chloride to pinene gives the familiar monohydrochloride (artificial camphor, m. p. 128°), from which, by withdrawal of hydrogen chloride, camphene, and not pinene, results. The addition of two molecules of hydrogen chloride to pinene gives rise to dipentene dihydrochloride (m. p. 50°), from which, by removal of 2 molecules of hydrogen chloride, a mixture of liquid isomerides of pinene is obtained. On the other hand, when pinene combines with nitrosylchloride, a compound is formed which contains a nitroso-group. This is indicated by the fact that it is capable of reacting with aniline to yield a diazotised product, leaving a hydrocarbon which is apparently identical with pinene, though optically inactive (Wallach, *Ann.*, 1889, **252**, 132; 1890, **258**, 344).

The authors have repeated this experiment, and although the reaction is not so simple as they were led to infer from Wallach's account of it, they have verified the fact that the recovered hydrocarbon combines readily with nitrosylchloride, forming a nitrosochloride which melts at 110°, and from which a benzylnitrolamine melting at 125° was obtained. The corresponding compounds formed from ordinary dextro-pinene melt at 103° and 122—123° respectively (Wallach). The fact that this recovered pinene is optically inactive but not resolvable into two optical isomerides has not attracted the attention it deserves. If optically inactive pinene really possesses the same constitution as active pinene, this would imply the existence in the molecule of two asymmetric carbon atoms similarly combined. The formulæ given by Wallach, Wagner, and other chemists are therefore inadequate to explain the facts.

In the hope of getting some new light on the problem, attempts have been made to produce new derivatives of the hydrocarbon by adding carbon in various forms to the unsaturated part of the molecule, with the idea of obtaining acids or other compounds of determinable constitution. Several methods have been tested in a preliminary way, but at present only one has met with success.

When pinene nitrosochloride is gently heated with an equivalent quantity of potassium cyanide in the presence of 90 per cent. alcohol, a compound having the composition of pinene nitrosocyanide is formed amounting to about 40 per cent. of the nitrosochloride employed. The viscous bye-products have not been completely examined. The cyanide is a crystalline compound which forms large prisms, of which the melting point is 171°. On analysis, the compound gave 14·47 per cent. of nitrogen, $C_{10}H_{16}NOCN$, requiring 14·58 per cent. It dissolves readily in alcohol, ether, acetic acid, and toluene, but very sparingly in light petroleum, and it is practically insoluble in water.

The constitution of this nitrosocyanide is at present an unsettled question. It is unaltered by boiling with 30 per cent. alcoholic potash for several hours. On the other hand, it is completely destroyed with formation of uncrystallisable products when heated with dilute sulphuric acid or with hydrochloric acid, either in alcoholic solution or in glacial acetic acid at 100°. It is therefore doubtful whether the compound is a nitrile. There are, however, other cases on record of nitriles which resist the action of alkalis, and the question is still under investigation.

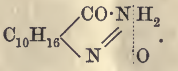
By digesting the cyanide with alcoholic potash and methyl iodide, a methyl derivative is produced which is distinguished by the readiness with which it forms large, colourless, prismatic crystals. The melting point of this compound is 67°, and it contains 13·64 per cent. of nitrogen, $C_{10}H_{15}CH_3{\cdot}NO{\cdot}CN$ requiring 13·60 per cent.

The action of reducing agents on the cyanide is rather remarkable. Three methods were successively employed, namely, (1) the action of sodium on a boiling solution of the cyanide in amyl alcohol, (2) the action of sodium on a boiling solution in ethyl alcohol, and (3) the action of zinc in the presence of alcohol and hydrochloric acid. In the reductions with sodium, some ammonia was evolved, and a cyanide was produced in considerable quantity, together with an almost quantitative yield of pinylamine.

The acid reducing agent produced practically no change, but when zinc dust and an alkaline solution were employed ammonia was evolved, and on steam distillation, an oil of camphoraceous odour passed over.

A small quantity of a second crystalline, but not basic, compound, not yet investigated, was produced in both cases, and was extracted from the alkaline residue.

Pinene nitrosocyanide dissolves in concentrated sulphuric acid without coloration but with evolution of considerable heat. The solution, when diluted with water, yields the unchanged nitrosocyanide, but when the solution in sulphuric acid is digested at about 100° for an hour or two, the addition of water does not cause an immediate precipitate. On allowing the liquid to stand, a new compound is deposited in tufts of crystals, which, after recrystallisation from alcohol, appear in the form of well-defined plates which melt and decompose at about 220°. It is soluble in aqueous potash, and, somewhat strangely, also in hydrochloric acid. This compound contains 14·38 per cent. of nitrogen, which corresponds closely with the amount required either by a polymerised product, $(C_{10}H_{16}\cdot NO\cdot CN)_n$, or by the product which would result from the formation of the corresponding acid amide and the subsequent elimination of water, thus:



This is, however, a subject for further investigation.

Pinene nitrosocyanide, placed in contact with warm nitric acid (sp. gr. 1·4), liquefies but does not dissolve, while a small quantity of nitrous gas is evolved. In a few minutes, the reaction seems to be complete, effervescence ceases, and on pouring the whole into cold water, a solid is precipitated which crystallises readily from alcohol in colourless prisms. This compound is insoluble in aqueous alkali. It melts with decomposition at 105°. Analysis gave 16·30 per cent. of nitrogen. The formula of a mononitrocyanide, $C_{10}H_{16}\cdot NO_2\cdot CN$, requires 13·46, while that of a dinitrocyanide, $C_{10}H_{15}(NO_2)_2CN$, requires 16·60 per cent. of nitrogen. It is probable, therefore, that the nitroso-group is oxidised and nitration occurs at the same time.

An attempt to produce a nitrosocyanide from limonene nitrosochloride gave a liquid product which is awaiting further investigation. Terpinene nitrosate is also expected to yield corresponding products.

With regard to the hydrochlorides obtainable from pinene, the monohydrochloride (m. p. 128°) refused to react under any circumstances with either cyanide of potassium or of silver. An alcoholic solution of dipentene dihydrochloride digested with potassium cyanide in the cold for 14 days gave the liquid monohydrochloride, $C_{10}H_{16},HCl$, and the latter, by continuing the action of the cyanide at about 120°, gave very pure terpinene, which was identified by its boiling point (181°) and by the production of the characteristic crystalline nitrosate.

*108. "The colour changes exhibited by the chlorides of cobalt and some other metals from the standpoint of the theory of electro-affinity." By F. G. Donnan and H. Bassett, jun.

The colour changes exhibited by aqueous and alcoholic solutions of the chlorides of cobalt, copper, and ferric iron on variation of temperature or dilution, or on the addition of various chlorides, such as those of hydrogen, calcium, magnesium, zinc, mercury, are shown to be largely due to the formation or dissociation of complex anions containing a metallic atom in association with chlorine. Evidence was brought forward to show that the dehydration theory is inadequate to explain the observed phenomena. Experiments on the motion of boundaries between different liquid layers on the passage of an electric current point to the existence of complex negative ions. Thus, in the case of cobalt chloride, the blue solutions travel towards the anode, the red solutions towards the cathode. Further experiments on the combination between cobalt and other chlorides in aqueous and alcoholic solutions admit of explanation on the above hypothesis.

*109. "The stereochemical formulæ of benzene." By J. E. Marsh.

The author discussed the objections to the stereocentric formulæ of benzene brought forward by Graebe (*Ber.*, 1902, **35**, 526), and pointed out that according to the latter, rings identical in structure, which their properties do not admit of, would be assigned to benzene and naphthalene. The author considers that all the eight stereocentric formulæ are possible for benzene and its derivatives; that orthophthalic acid would have the *trans*-centric form, in which case it could form an anhydride, though the meta-acid could not, since the hexahydro-ortho-acid alone forms an anhydride in the *trans*-form. Thus, proximity of groups alone would not account for the formation of anhydrides, nor of carbonates and methylene ethers of dihydric phenols. Further, the absence of optically active compounds is accounted for if we regard the Kekulé formula as a labile form of the *cis*-centric, for the Kekulé model can close in in two ways to form *cis*-centric formulæ, one being the optical image of the other.

With regard to substitution, those compounds which yield meta-derivatives contain an oxidisable group, whilst those which yield ortho-

and para-derivatives contain a reducible group. In the former case, the repulsion of hydrogen leads to the *trans*-centric form with production of meta-derivatives. In the latter case, the attraction of hydrogen to the group leads to *cis*-centric hydrogen in the ortho- and para-positions. Bamberger's dicentric formula for naphthalene was also criticised, as it appears stereochemically impossible and is not in accord with the constitution of allied hydrocarbons.

*110. "An accurate method of determining the compressibility of vapours." By B. D. Steele, D.Sc.

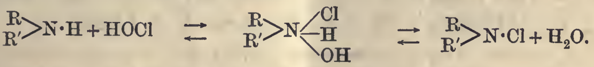
In the course of an investigation with Prof. Ramsay, it became necessary to determine, with a high degree of accuracy, the compressibility of certain vapours at low pressures. The apparatus employed consists of a combination of volume apparatus and pressure gauge, so constructed as to be capable of being contained together in a glass jacket which can be maintained at a constant temperature. The pressure is measured by setting two surfaces of mercury to carefully ground glass points the difference in level between which is known. The volume is obtained by weighing the mercury entering or leaving the apparatus.

Experiments with the vapours of benzene and ether have been made in the apparatus, and curves obtained showing the variation of PV with P for pressures varying from 40 to 200 mm.

*111. "A new type of substituted nitrogen chlorides." By F. D. Chattaway.

No substituted nitrogen chlorides known up to the present have three negative groups attached to the nitrogen. All contain at least one hydrocarbon residue.

Such a series of compounds of the type $\begin{smallmatrix}R\\R'\end{smallmatrix}\!\!>\!N\cdot Cl$, where R and R′ are acyl groups, is yielded by the diacyl amides. These, when treated with hypochlorous acid or, under certain conditions, with chlorine have their imino-hydrogen replaced by chlorine, thus:



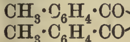
$$\begin{smallmatrix}R\\R'\end{smallmatrix}\!\!>\!N\cdot H + HOCl \rightleftarrows \begin{smallmatrix}R\\R'\end{smallmatrix}\!\!>\!N\!\begin{smallmatrix}\diagup Cl\\ -H\\ \diagdown OH\end{smallmatrix} \rightleftarrows \begin{smallmatrix}R\\R'\end{smallmatrix}\!\!>\!N\cdot Cl + H_2O.$$

The diacyl nitrogen chlorides are colourless, well-crystallised compounds which show the typical behaviour of substances having halogen attached to nitrogen.

Dibenzoyl Nitrogen Chloride, $\begin{smallmatrix}C_6H_5\cdot CO\\C_6H_5\cdot CO\end{smallmatrix}\!\!>\!N\cdot Cl$.—In order to obtain this compound, dibenzamide, prepared by the action of fuming sulphuric acid and phosphorus pentoxide on benzonitrile, was dissolved in acetic acid. To the solution, an excess of a strong solution of bleaching powder was added. Chlorine was vigorously evolved and a yellow oil separated. Chloroform was added and the whole well shaken for a few minutes. The chloroform solution was then run off, washed with water, and finally with a dilute solution of potassium bicarbonate, dried over fused calcium chloride, and the solvent evaporated at a low temperature in a rapid current of dry air. The nitrogen chloride crystallised out as a white solid (m. p. 89°), readily soluble in chloroform and in benzene, but sparingly in petroleum. It crystallises from a mixture of chloroform and petroleum (b. p. 60—80°) in colourless, six-sided prisms with domed ends. It was analysed in the usual way, by adding an excess of hydriodic acid to a weighed quantity dissolved in chloroform, and estimating the liberated iodine by a standard solution of sodium thiosulphate:

0·2446 liberated $I = 18·7$ c.c. *N*/10 I. Cl as $:N\cdot Cl = 13·55$.
$C_{14}H_{10}O_2:N\cdot Cl$ requires Cl as $:N\cdot Cl = 13·65$ per cent.

When heated with water or dilute acids it is hydrolysed, hypochlorous acid being liberated and dibenzamide re-formed, the latter undergoing further hydrolysis to benzoic acid and benzamide, and finally, if the heating be prolonged, to benzoic acid and ammonia.



Di-p-*toluyl Nitrogen Chloride*, $\begin{matrix}CH_3\cdot C_6H_4\cdot CO\\ CH_3\cdot C_6H_4\cdot CO\end{matrix}>N\cdot Cl$.—This was prepared from di-*p*-toluylamide by the method previously described. It closely resembles the dibenzoyl derivative in properties and in solubility. It crystallises in long, colourless, six-sided prisms with domed ends (m. p. 129°).

0·2121 liberated $I = 14·8$ c.c. *N*/10 I. Cl as $:N\cdot Cl = 12·37$.
$C_{16}H_{14}O_2:N\cdot Cl$ requires Cl as $:N\cdot Cl = 12·32$ per cent.

The author desires to reserve the further investigation of these and similar compounds.

*112. "The preparation of pure chlorine and its behaviour towards hydrogen." By J. W. Mellor and E. J. Russell.

A quantity of carefully dried and purified silver chloride was placed in a V-shaped tube of the hardest Jena glass, in which were also inserted, as electrodes, stout carbon rods specially prepared for the electrolysis of fused salts. An air-tight joint having been made, the salt was fused and a current of 2·8 amperes passed through. Chlorine was evolved in a steady stream. Foreign gases and moisture were removed by occasional reversal of the current and repeated exhaustion with an automatic Sprengel pump.

The silver tree was destroyed by raising the temperature and increasing the current to 5 amperes. The tree then either melted or was shattered; electrolysis was discontinued until the former temperature was restored; when started again, it was found to proceed in a normal manner.

Hydrogen was prepared by the action of steam on sodium and was absorbed by palladium. The whole apparatus was then exhausted, the palladium heated, and hydrogen evolved.

The gases were sealed up in the inner and outer bulbs respectively of the condensers now largely used with Soxhlet extractors. Each bulb contained a quantity of carefully purified phosphorus pentoxide, the inner bulb containing also a small piece of glass rod. After drying for some months in the dark, the vessels were shaken to break the inner bulb and the gases mixed by diffusion. Only condensers which had approximately equal capacities for the inner and outer bulbs were used; hydrogen was put in at the same pressure as the chlorine, so that the volumes of the two gases were nearly equal.

A small electric spark passed through a mixture so obtained caused an explosion, and combination was found to have been practically complete. Apparently drying does not affect the action of the spark.

Mixtures of moist hydrogen and chlorine in similar bulbs were found to explode at about 260°. One of the bulbs containing the purified mixture was therefore heated to 270° for some minutes, but no explosion took place. On opening the bulb, it was found that there had been practically no combination. Another bulb was heated for 10 minutes to 450°. Still no explosion occurred, but about 80 per cent. of the mixture had combined. Some of the phosphorus pentoxide had volatilised, and as it was found impossible to heat the gases without also heating the pentoxide, it is still uncertain whether this slow combination is a direct action or a surface action. Another bulb was exposed to bright sunshine at Wye for 3 days, but no explosion took place; and only about 30 per cent. of the hydrogen and chlorine had combined.

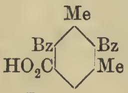
*113. "Derivatives of dibenzoylmesitylene." By W. H. Mills and T. H. Easterfield.

The authors described a method of preparing dibenzoylmesitylene by which it may be obtained in quantity, and methods for the production and isolation of the five acids which result by the successive oxidation of its methyl groups, namely, *asym.*dibenzoylmesitylenic acid, m. p. 174°, *sym.*dibenzoylmesitylenic acid, m. p. 222°, *asym.*dibenzoyluvitic acid, m. p. 211°, *sym.*dibenzoyluvitic acid, m. p. 262°, and dibenzoyltrimesic acid, m. p. 250°.

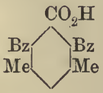
A mixture of these, of which *asym.*dibenzoylmesitylenic acid is by far the largest constituent, is obtained by boiling the ketone with dilute nitric acid the boiling point of which has been raised by the addition of large quantities of potassium and sodium nitrates.

The two dibenzoyluvitic acids are most conveniently prepared by treating the easily obtainable *asym.*dibenzoylmesitylenic acid with one equivalent of potassium permanganate in alkaline solution. If double this amount of potassium permanganate be used, dibenzoyltrimesic acid is obtained.

The constitution of these acids readily follows from the following facts :



I.



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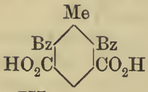
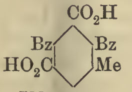
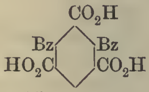


III.



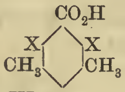
IV.



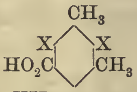
V.

The dibenzoylmesitylenic acid of melting point 174°, oxidised with potassium permanganate, yields a mixture of *both* dibenzoyluvitic acids. It must therefore be the asymmetrical acid of formula I. The dibenzoylmesitylenic acid of melting point 222°, similarly treated, yields only *one* dibenzoyluvitic acid melting at 211°. Hence, it must be represented by formula II and the dibenzoyluvitic acid resulting from it by IV. The dibenzoyluvitic acid melting at 262° must therefore be represented by III, and for dibenzoyltrimesic acid, only one formula is possible, namely, V.

In working with these acids, the fact was discovered (also noticed by Graebe, *Ber.*, 1900, **33**, 2026) that diortho-substituted acids do not obey V. Meyer's esterification rule when the ortho-substituents are benzoyl groups :



VI.



VII.

whereas it follows from V. Meyer's work that the esterification constant of an acid of formula VI would in general be indefinitely smaller at the ordinary temperature than that of an acid of formula VII, in the case where X is a benzoyl group it is smaller only in the ratio of approximately 0·65 to 1·0.

114. "The molecular condition of borax in solution." By H. S. Shelton.

Borax (Shields, *Phil. Mag.*, 1893, **35**, 365) is slightly hydrolysed into sodium hydroxide and boracic acid. Experiments on the diminution of conductivity on the addition of further quantities of boracic acid show an increase of this hydrolysis when further diluted with water, and also with increase of temperature. In *N*/10 solution, the hydrolysis was estimated by Shields to be 0·5 per cent. at 25°, and the experiments of the author with *N*/200 solution showed 4 per cent. at 25° and 6 per cent. at 50°. Kahlenberg and Schreiner (*Zeit. Phys. Chem.*, 1896, **20**, 547) concluded from freezing point determinations that six chemical individuals are present in a dilute solution of borax.

These chemical individuals seem to be $2H_3BO_3,2\underset{+}{Na}\underset{-}{BO_2}$, as shown by the following equation:

$$Na_2B_4O_7Aq + 3H_2O = 2NaAq,2BO_2Aq + 2H_3BO_3.$$

The author has confirmed this by a number of direct experiments, amongst which the most important is the precipitation of $AgBO_2$, and determination of the boracic acid remaining in the solution.

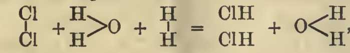
115. "On the union of hydrogen and chlorine. Part V." By J. W. Mellor, D.Sc.

There is no experimental evidence to show that chlorine gas under the influence of light undergoes any change capable of appreciably affecting the chemical activity of that element towards hydrogen. Part of the energy absorbed by moist chlorine from sunlight is dissipated as heat. This causes the Budde effect. Under the influence of light, chlorine sets up and maintains in a state of equilibrium a reversible reaction with water vapour, possibly $2H_2O + 2Cl_2 \rightleftarrows 4HCl + O_2$. Dry chlorine does not exhibit the Budde effect. The rise in temperature of imperfectly dried chlorine when exposed to sunlight appears to be due to some chemical reaction between the moisture and the chlorine gas. A layer of moist chlorine just thick enough to screen a bulb of mixed hydrogen and chlorine gases from chemical action is not sufficient to prevent chemical action if the chlorine is dried by means of purified phosphorus pentoxide. The actinic energy continuously absorbed from sunlight by moist chlorine is dissipated in at least three ways: (1) in maintaining the above chemical reaction

(2) by conversion into heat during molecular impacts; (3) as external non-actinic radiations from the molecules moving in their free path between molecular collisions.

116. “On the union of hydrogen and chlorine. Part VI.” By J. W. Mellor, D.Sc.

If the reaction between hydrogen and chlorine in the presence of moisture is assumed to take place with the formation of an intermediate compound, the period of induction is a direct consequence of the law of mass action. Since neither chlorine monoxide nor hydrogen hypochlorite abbreviate the period of induction, neither of these substances can take part as intermediate compounds in the reaction between hydrogen and chlorine. Since chlorine acquires no appreciable chemical activity by exposure to sunlight, the presence of hydrogen as well as of moisture determines the greater chemical activity of an induced mixture of hydrogen and chlorine gases. If an intermediate compound takes part in the reaction between hydrogen and chlorine in the presence of moisture, the most probable “compound” satisfying the required conditions contains $x\mathrm{Cl}_2,y\mathrm{H}_2\mathrm{O},z\mathrm{H}_2$, where x, y, z, are positive integers. The explanation offered by the two dependent reactions involved in the equation,



$$\begin{matrix}\mathrm{Cl}\\|\\\mathrm{Cl}\end{matrix} + \begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\!\!>\!\mathrm{O} + \begin{matrix}\mathrm{H}\\|\\\mathrm{H}\end{matrix} = \begin{matrix}\mathrm{ClH}\\\mathrm{ClH}\end{matrix} + \mathrm{O}\!<\!\!\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix},$$

remains to be studied.

117. “On some hydroxy-pyrone derivatives.” By T. Tickle and J. N. Collie, F.R.S.

During some work on the constitution of meconic acid, the authors found that it was necessary to prepare certain hydroxypyrone derivatives in order to compare their properties (especially their colour reactions with ferric chloride) with those of meconic acid.

Dimethylpyrone, when treated with hydrogen peroxide in presence of a ferrous salt, yields hydroxydimethylpyrone, $\mathrm{C_7H_8O_2 + H_2O_2 = C_7H_8O_3 + H_2O}$. This substance crystallises from water in colourless needles; it can be sublimed without decomposition and melts at 162·5°. With ferric chloride, it gives a deep violet-blue colour. Its monacetyl derivative melts at 98° and does not colour an aqueous solution of ferric chloride.

Meconic acid, when treated in the same manner with hydrogen peroxide, gives carbon dioxide and hydroxycomenic acid, $\mathrm{C_7H_4O_7 + H_2O_2 = C_6H_4O_6 + CO_2 + H_2O}$. Hydroxycomenic acid seems to be a dibasic acid; it gives an intense violet with ferric chloride, melts at

275°, and crystallises from water in long, fine needles. It seems probable that this is the same acid as that first obtained by Reibstein (*J. pr. Chem.*, 1881, [ii], **24**, 286) by the action of barium hydroxide on bromocomenic acid. He, however, gives no melting point for the acid, but only for the ethyl ester, 204°, and for the diacetoxyl derivative, 75°. The authors find that these derivatives prepared from this acid melt at 207·5° and 75° respectively.

All attempts to prepare either meconic acid or hydroxycomenic acid by oxidation of chelidonic acid were unsuccessful.

118. "The absorption spectra of phloroglucinol and some of its derivatives." By W. N. Hartley, D.Sc., F.R.S., J. J. Dobbie, D.Sc., M.A., and A. Lauder, B.Sc.

Phloroglucinol reacts with some reagents as a phenol, with others as a ketone. It is impossible, therefore, from its chemical behaviour to decide whether its oxygen atoms are present in hydroxyl groups or in direct union with carbon. The trimethyl derivative of phloroglucinol (m. p. 52°) is regarded as a true ester, since its methoxyl groups are split off by heating with hydrogen iodide. The absorption spectra of this substance and of phloroglucinol were found to be almost identical. From this it follows that if the structure of the ester has been correctly established, phloroglucinol also must have the enolic structure (*Trans.*, 1899, **76**, 640; 1900, **77**, 839). Aqueous and alcoholic solutions of phloroglucinol show both general and selective absorption. A layer 50 mm. thick of a solution containing 1 milligram-mol. in 20 c.c. water, absorbs all rays beyond λ 3009, whilst a layer 5 mm. thick absorbs all rays beyond λ 2802. The absorption-band is not strongly marked; it appears first in a layer 3 mm. thick of the solution containing 1 milligram-mol. in 100 c.c. water, and nearly dies out in a layer 2 mm. thick, although its position is still distinctly traceable by the weakness of the spectra in solutions of greater dilution. The resemblance between the spectra of phloroglucinol and the trimethyl derivative is so close that phloroglucinol cannot consist of a mixture of the enolic and ketonic forms.

The specimens of phloroglucinol examined were prepared from five different sources, namely, kino, maclurin, resorcinol, phenol (by fusion with sodium hydroxide), and phloroglucinoltricarboxylic ester. The specimens from these various sources had the same melting point. The melting point is greatly influenced by the rate of heating, varying between 210° and 217°. The absorption curves of all the specimens agree perfectly. The authors conclude from the identity of the spectra that the structure of phloroglucinol, no matter from what source it is obtained or by what method it is prepared, is always the same.

The spectra of pyrogallol were also re-examined, and the curve was found to resemble very closely that of phloroglucinol, thus confirming the conclusion that the latter substance has the enolic structure.

119. "Solubility of mannitol, picric acid, and anthracene." By A. Findlay.

Determinations of the solubility of mannitol in water, of picric acid in water and in benzene, and of anthracene in benzene, have been made at several temperatures between 25° and 60°.

It has already been shown by the author (*Proc. Roy. Soc.*, 1902, **69**, 471) that if the solubility curve of one substance is known, that of another substance can be calculated from two, or better, three, determinations of the solubility of the second substance at different temperatures. The formula used for this purpose is one analogous to that employed by Ramsay and Young for the calculation of vapour pressures, and has the form $T_1/T_1' = T_2/T_2' + c(t' - t)$, where T_1/T_1' and T_2/T_2' denote the absolute temperatures at which the two substances have the same solubility, c is a constant, and t' and t are the temperatures at which one of the substances has the solubility corresponding to the absolute temperatures T_1 and T_2 or T_1' and T_2'. This formula has been employed in the present case for calculating the solubilities of the above substances between 0° and 25°, and between 60° and 100° (in the case of anthracene and picric acid, in benzene up to the boiling point of the latter).

120. "Menthyl formylphenylacetate." By J. B. Cohen and S. H. C. Briggs.

A short time ago, the authors commenced a similar investigation to that of Lapworth and Hann (this vol., p. 144) with the object of studying tautomeric changes by means of optically active substances, in the course of which they prepared menthyl formylphenylacetate described by Lapworth and Hann. As the authors do not intend, under the circumstances, to pursue this line of inquiry, they desire to record their observations, which, though they confirm on the whole the results given in the paper referred to, show some slight differences. Menthyl formylphenylacetate was prepared as follows. Sodium was allowed to act on a mixture of menthyl acetate and ethyl formate dissolved in dry ether. In this reaction, an interchange occurs to some extent between the menthyl and ethyl groups so that some menthyl formate, and some ethyl formylphenylacetate are produced. The product was poured into water, the ethereal layer removed, and the aqueous portion acidified and shaken out with ether. The ether was evaporated in a vacuum, and crystals of menthyl formylphenylacetate separated on standing. The menthyl ester thus obtained was in the form of large, well-formed, tetragonal crystals consisting of four-sided prisms terminated by pyramids; purified by recrystallisation from chloroform, it melted at 82—84° (L. and H. give 82—83°). The specific rotation of a freshly prepared chloroform solution containing about 3 grams of substance in 100 c.c. is $[\alpha]_D^{18°} = -72·6°$ (L. and H. give $-74·6°$). In an alcoholic solution containing 2 grams in 100 c.c., the specific rotation was $[\alpha]_D^{18°} = -63·9°$ (L. and H. give $-64·9°$). The addition of sodium ethylate did not affect the rotation. The following were the effects of an alcoholic solution of ferric chloride on the substance when dissolved in various solvents. A faint violet coloration was produced in methyl and ethyl alcohol, ether, and light petroleum. No coloration was produced at first in benzene, chloroform, or ethyl acetate but slowly developed. Menthyl phenylacetate, obtained in the preparation of the formylphenylacetate, is a colourless and odourless liquid which boils at 216° (39 mm.).

*121. "Transformation of diacetanilide into aceto-*p*-amino-acetophenone." By F. D. Chattaway.

A large number of derivatives of primary aromatic amines in which various atoms or groups are attached to the nitrogen readily undergo intramolecular transformation and form isomerides in which the atom or group is attached to the nucleus in the para- or ortho-position. The best known examples of such changes are those in which a halogen atom, a nitro-group, a sulphonic group, or a hydroxyl group passes on to the ring. So far, however, the commonest substituting group in amines, the acetyl group, has not been observed to wander. The author described experiments in which this group passed into the ring in the normal manner. The substance studied was diacetanilide, which underwent transformation into aceto-*p*-amino-acetophenone.

122. "Nitrogen chlorides and bromides derived from ortho-substituted anilides." By F. D. Chattaway and J. M. Wadmore.

Nitrogen halogen derivatives of orthochlorobenzanilide and orthobromobenzanilide, which have not hitherto been described, are easily obtained by treating the corresponding anilides with an excess of hypochlorous or hypobromous acid, the actions, as in other similar cases, being reversible. The nitrogen chlorides and bromides so obtained show all the typical nitrogen halogen group reactions and readily undergo transformation into the isomeric 2:4-disubstituted anilides.

The following compounds have been prepared:

Benzoyl-o-*chlorophenyl nitrogen chloride*, $C_6H_4Cl{\cdot}NCl{\cdot}COC_6H_5$, colourless, six-sided plates, m. p. 94°. *Benzoyl*-o-*chlorophenyl nitrogen bromide*, $C_6H_4Cl{\cdot}NBr{\cdot}COC_6H_5$, short prisms of a deep yellow colour, m. p. 110°. o-*Bromobenzanilide*, $C_6H_4Br{\cdot}NH{\cdot}COC_6H_5$, colourless, rectangular plates, m. p. 116°. *Benzoyl*-o-*bromophenyl nitrogen chloride*, $C_6H_4Br{\cdot}NCl{\cdot}COC_6H_5$, colourless, transparent prisms, m. p. 85°. *Benzoyl*-o-*bromophenyl nitrogen bromide*, $C_6H_4Br{\cdot}NBr{\cdot}COC_6H_5$, yellow, six-sided, rhombic prisms, m. p. 99°. *Acetyl*-o-*chlorophenyl nitrogen bromide*, $C_6H_4Cl{\cdot}NBr{\cdot}COCH_3$, pale yellow, four-sided prisms, m. p. 152°. *Acetyl*-o-*bromophenyl nitrogen chloride*, $C_6H_4Br{\cdot}NCl{\cdot}COCH_3$, colourless, four-sided prisms, m. p. 86°.

123. "Substituted nitrogen chlorides containing the azo-group." By F. D. Chattaway.

In order to determine the effect of an azo-group on the properties and direction of transformation of nitrogen chlorides, a number of such compounds have been prepared from aminoazobenzene. Aminoazobenzene yields well crystallised acetyl, propionyl, and benzoyl derivatives, which react with hypochlorous acid very readily and form nitrogen chlorides possessing all the characteristic properties of the nitrogen halogen group. This adds another to the many reasons for regarding aminoazo-compounds as primary amino-derivatives.

The following compounds have been prepared:

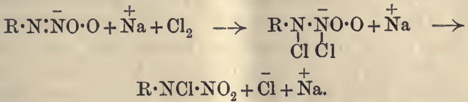
p-*Acetylchloroaminoazobenzene*, $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NCl{\cdot}COCH_3$, orange-red plates, m. p. 113·5°. *Propionyl*-p-*aminoazobenzene*, $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NH{\cdot}COC_2H_5$, large, orange-red plates, m. p. 170°. p-*Propionylchloroaminoazobenzene*, $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NCl{\cdot}COC_2H_5$, red prisms, m. p. 57°. *Benzoyl*-p-*aminoazobenzene*, $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NH{\cdot}COC_6H_5$, reddish-orange plates, m. p. 211°. p-*Benzoylchloroaminoazobenzene*, $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NCl{\cdot}COC_6H_5$, red-brown, glistening, flattened prisms, m. p. 144°.

124. "The action of chlorine and bromine on nitroaminobenzenes. Part I. *s*-Trisubstituted chloronitroaminobenzenes." By K. J. P. Orton.

In the course of an investigation of the conditions under which the nitroamines derived from *s*-trisubstituted anilines (this vol., p. 111) are transformed into substances containing the nitro-group in the benzene nucleus, the action of chlorine and bromine on these substances was studied.

When chlorine is passed into an aqueous solution of the sodium salt of a nitroamine, or when dilute aqueous bleaching powder is slowly added to a solution of the nitroamine in acetic acid, the chloronitroamine is formed; thus 1-nitroamino-*s*-trichlorobenzene yields 1-*chloronitroamino*-s-*trichlorobenzene*, $C_6H_2Cl_3{\cdot}NCl{\cdot}NO_2$.

As the sodium (and other) salts of the nitroamines may probably be represented by the formula $R{\cdot}N{:}NO{\cdot}ONa$, and, if so, would be the salts of a substituted "iminonitronic acid" (compare Bamberger, *Ber.*, 1902, **35**, 54), the author suggested that the reaction of chlorine with the sodium salt might be represented thus:



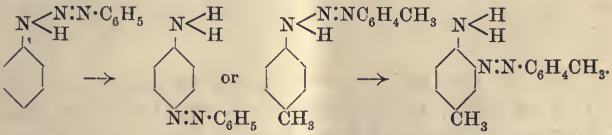
$$R{\cdot}N{:}\overset{-}{N}O{\cdot}O+\overset{+}{N}a+Cl_2 \longrightarrow R{\cdot}\underset{Cl}{N}{\cdot}\underset{Cl}{\overset{-}{N}}O{\cdot}O+\overset{+}{N}a \longrightarrow R{\cdot}NCl{\cdot}NO_2+\overset{-}{Cl}+\overset{+}{N}a.$$

All these chloronitroamines are very unstable, and are reconverted by all reagents into the nitroamines. The following compounds, all of which crystallise in lustrous, colourless prisms, have been prepared: 1-*Chloronitroamino*-s-*trichlorobenzene*, m. p. 53—54°; 1-*chloronitroamino*-s-*tribromobenzene*, m. p. 61°; 1-*chloronitroamino*-4-*chloro*-2 : 6-*dibromobenzene*, m. p. 56°; 1-*chloronitroamino*-2 : 3 : 4 : 6-*tetrabromobenzene*, m. p. 61—62°; 2-*chloronitroamino*-3 : 5-*dibromotoluene*, m. p. 60°; 4-*chloronitroamino*-3 : 5-*dibromotoluene*, m. p. 50—51°.

By the action of bromine on aqueous solutions of the sodium salts of the nitroamines, the bromonitroamino-derivatives are formed, but have not been obtained free from the nitroamine.

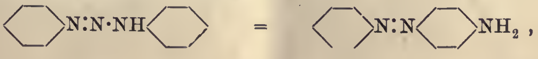
125. "The transformation of diazoamido- into aminoazo-compounds and of hydrazobenzene into benzidine." By F. D. Chattaway.

The transformation of diazoamido- into the isomeric aminoazo-derivatives is similar in nature to the other well-known transformations in which atoms or groups of atoms pass from the nitrogen of an amino-group attached to a benzene nucleus into the para- or ortho-position in the ring, thus:



As is usual in these intramolecular changes, the para-position is taken up by preference, the ortho-position to a less extent, or exclusively when the para-position is already occupied.

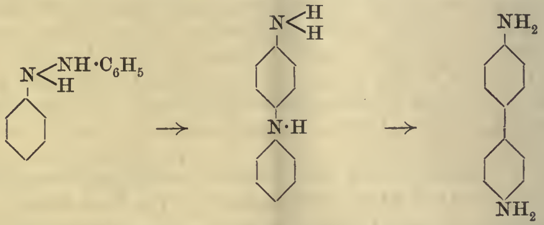
This analogy is somewhat obscured by the ordinary method of representing the transformations,



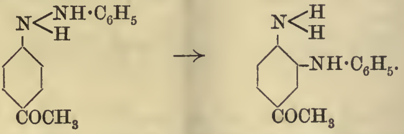
where the NH group appears to leave the chain and pass into the ring.

The formation of the various azo-derivatives which are obtained by heating diazoamido-compounds with aromatic amines and their hydrochlorides, is thus rendered intelligible without assuming the formation of intermediate nitrogen halogen compounds (Goldschmidt and Bardach, *Ber.*, 1892, 25, 1376). It is only necessary to assume the existence of a mobile hydrogen atom and double linkage in the diazoamido-compounds, and to admit that the diazo-group can undergo transference from the nitrogen atom of one amine to that of another, present in large excess, exactly as a chlorine or bromine atom does. Much that is known of similar isomeric changes points to the conclusion that transference from nitrogen to the ring can only take place when the nitrogen is exerting its higher valency. This may explain the advantage, in these transformations, of the hydrochloride of the base.

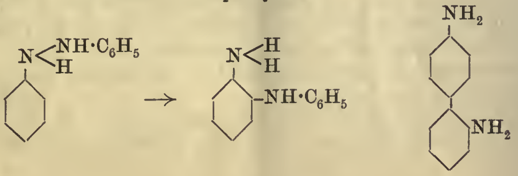
The isomeric change of hydrazobenzene into benzidene is also brought into line with other analogous transformations if similarly formulated:



It is seen to consist of two stages, of which the first only can take place if the para-position is already occupied, the semidine and other similar transformations resulting:



As is well known, the related ortho-change also takes place to some extent with the formation of diphenyline,



in all probability, the ortho-change also takes place to a relatively very small extent in the second stage with the production of diorthoaminodiphenyl, though the latter is produced in such small quantity that it has hitherto escaped detection.

126. "Tribromophenolbromide." By E. W. Lewis.

A re-examination of this substance has shown that the melting point usually attributed to it (118°) is much too low, and that it may be raised to 148—149° by recrystallising the compound from ethyl acetate; moreover, whilst, as usually stated, the substance of low melting point gives off bromine on heating at about 125°, the purified material begins to lose bromine before melting at about 145°.

The crystals of tribromophenolbromide belong to the orthorhombic system, the axial ratios being $a : b : c = 0{\cdot}7945 : 1 : 1{\cdot}5921$.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Mann, Harold H. Studies in the chemistry and physiology of the tea leaf. Part I. The enzymes of the tea leaf. Pp. 13. 1901.
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Fowler, Gilbert J. Sewage works analyses. Pp. 135. London 1902. From the Publisher.

Sorel, E. La grande industrie chimique minérale. Soufre. Azote. Phosphates. Alun. Pp. 809. Paris 1902. From the Publishers.

II. *By Purchase.*

Duhem, E. Le mixte et la combinaison chimique, essai sur l'evolution d'une idée. Pp. 207. Paris 1902.

Kohlrausch and Holborn. Das Leitvermögen der Elektrolyte insbesondere der Lösungen. Methoden, Resultate, und chemische Anwerdungen. Pp. 211. Leipzig 1898.

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Wilfarth, H., and G. Dimmer. Die Wirkung des Kaliums auf das Pflanzenleben nach Vegetationsversuchen mit Kartoffeln, Tabak, Buchweizen, Senf, Zichorien und Hafer. (Arbeiten der Deutschen Landwirtschafts-Gesellschaft. Heft. 68.) Pp. 106. Berlin.

Schmucken, Martin. Secretorum Naturalium, Chymicorum, et Medicorum Thesauriolus, oder Schatzkästlein darinnen 20 natürliche, 20 chymische, und 20 medicinische Secreta, und Künst Stücklein zu befinden, durch vielfältige Reisen, Mühe, und Gefahr colligiret, und an Tag gegeben, von M. S. Lipsensi, der Artzeney Licenciato. Pp. 80. Schleusingen 1637. Thesaurioli. Pars altera. Pp. 104. Nürnberg 1637.

Kesler, Thomas. Keslerus redivivus das ist Fünff Hundert ausserlesene chymische Process und Artzneyen, theils zu innerlichen und eusserlichen Leibskranckheiten theils auch zu Verbesserung der mindern Metallen hochnutzlich. Deren erstlich Vier Hundert durch T. K. Chymicum et civem Argentinensem an Tag gegeben und zum vierdten mal auffgelegt, an jetzo aber von einem vornehmen Chymico auffs new ubersehen, und mit Hinzusetzung dess fünfftenhunderten in formliche Ordnung und gewisse Classes gesetzet. Pp. xvi + 550. Frankfurt-a.-M. 1641.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 255.

The following are abstracts of papers received during the vacation, and published, or passed for publication, in the *Transactions* :

127. "On the solvent properties of mixed liquids in relation to the chemical characters and solvent properties of their components." By H. M. Dawson.

The solvent power of mixtures of liquids in its relationship to that of the components has been investigated under conditions such that complicating secondary effects of electrolytic dissociation, high concentration of the solutions, and interaction of the component liquids are avoided.

Measurements of the solubility of iodine were obtained by determining the ratio of distribution between water as standard substance on the one hand, and mixtures of organic solvents on the other. A method of determining this partition ratio is described in which an aqueous solution of potassium iodide is employed instead of pure water. If the iodine concentration in the aqueous solution remains the same in all experiments, the conditions of experimentation correspond almost exactly with the determination of the solubility of a gas in different liquids, the pressure of the gas being kept constant. The organic solvents chosen were such as would not be expected to have any action on each other, or on the dissolved iodine. In these circumstances, it is found that in the majority of cases the solvent power of the mixture is less than the sum of the solvent powers of the components; sometimes, however, it is equal to, or greater than, the sum of the solvent powers of the components. No case of a maximum or minimum solvent power, such as that observed with alcohol-water mixtures in regard to hydrogen, oxygen, carbon monoxide, and carbon dioxide has been found.

128. "Notes on luteolin and apigenin." By A. G. Perkin.

Kiliani and Mayer (*Ber.*, 1901, 34, 3577) have recently asserted that the author's tetrabenzoyl-luteolin (*Trans.*, 1896, 69, 209) is in reality a tribenzoyl derivative. A re-examination of the original preparation shows that the statement of Kiliani and Mayer is incorrect, and that the substance is without doubt tetrabenzoyl-luteolin. Further experiments with reference to the tinctorial properties of apigenin and chrysin confirm the previous results of the author (*Trans.*, 1897, 71, 806).

129. "Note on a simple form of Landsberger's apparatus." By E. B. Ludlam.

A description is given of an apparatus which has proved most satisfactory to work with. The tube in which the rise of temperature is measured is graduated and placed in the neck of the flask containing the boiling solvent, the vapour of which enters it from below by means of a simple valve which serves the double purpose of regulating and breaking up the stream of vapour, and also of preventing the solution from running back into an intermediate tube, placed between the incretometer and the flask, when the latter is cooled.

The graduated tube is also provided with an annular trough which serves as a trap and catches the liquid condensed in the upper part of the tube, conveying it to the condenser, thus making the increase of volume in the tube much slower than it otherwise would be.

130. "The action of substituting agents on benzeneazo-β-naphthol." By J. T. Hewitt and S. J. M. Auld.

Bromine added to benzeneazo-β-naphthol suspended in glacial acetic acid furnishes *p*-bromobenzeneazo-β-naphthol, a result also obtained by Margary (*Gazzetta*, 1883, 13, 438), who assigned to the substance the melting point 160—161°, but which the authors, like Bamberger, find to be 172—173°. In presence of sodium acetate, such a high temperature is necessary before the bromine will attack the azo-compound that the results obtained lead to no definite conclusion as to the structure of benzeneazo-β-naphthol.

Nitric acid in presence of concentrated sulphuric acid nitrates the azonaphthol in the benzene nucleus (para-position), dilute nitric acid attacks benzeneazo-β-naphthol on warming, giving 1 : 6-dinitro-β-naphthol as the chief product, and *p*-nitrobenzeneazo-β-naphthol in smaller amount.

With strong acids, benzeneazo-β-naphthol behaves as a quinonehydrazone; with dilute acids (nitric) or weak acids (acetic) its reactions are more those of an azonaphthol.

131. "The condensation of dimethylaminobenzaldehyde with β-naphthol. By **J. T. Hewitt, A. J. Turner, B.Sc., and S. W. Bradley.**

When hydrochloric acid is added to a solution of dimethylaminobenzaldehyde and β-naphthol in cold glacial acetic acid, crystals of the composition $HCl,(CH_3)_2N\cdot C_6H_4\cdot CH(C_{10}H_6OH)_2$ are deposited; these darken at about 150° and melt at 215° with decomposition. If, however, a mineral acid be added to a hot glacial acetic acid solution of the aldehyde and β-naphthol, a salt of the corresponding anhydride is produced.

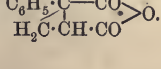
Attempts at oxidation were without result; even bromine does not yield an oxonium salt, but gives the bromide of a bromo-substitution product, $C_{29}H_{22}BrON,HBr$ (m. p. 196°, uncorr.).

132. "The action of ethyl chlorofumarate on monoalkylmalonic esters." By **S. Ruhemann.**

The author finds that, in the presence of sodium ethoxide, ethyl chlorofumarate reacts with the mono-alkyl derivatives of ethyl malonate to yield homologues of ethyl carboxyaconitate according to the equation:

$$R\cdot CNa(CO_2Et)_2 + CO_2Et\cdot CCl\colon CH\cdot CO_2Et = R\cdot C(CO_2Et)_2\cdot C(CO_2Et)\colon CH\cdot CO_2Et + NaCl.$$

The quantity of the unsaturated ester which is produced is small, and decreases as the radicle in the substituted malonic ester increases. Of several homologues prepared, the author has studied especially ethyl phenylcarboxyaconitate, $C_6H_5\cdot C(CO_2Et)_2\cdot C(CO_2Et)\colon CH\cdot CO_2Et$, and finds that, on hydrolysis, it loses two molecules of water, and yields a compound, $C_{11}H_8O_3$, which is the anhydride of a dicarboxylic acid. This anhydride is not an unsaturated compound, but a derivative of trimethylene having the formula



$$\begin{array}{l} C_6H_5\cdot C\!-\!CO \\ H_2C\cdot CH\cdot CO \end{array}\!\!>\!O.$$

On reduction with sodium amalgam, this compound yields *s*-phenylmethylsuccinic acid, $C_6H_5{\cdot}CH(CO_2H){\cdot}CH(CH_3){\cdot}CO_2H$ (m. p. 193°), which is identical with the acid described by Zelinsky and Buchstab (*Ber.*, 1891, 24, 1876).

133. "Di-*sec.*-octyl tartrate and di-*sec.*-octyl dibenzoyl tartrate."

By J. McCrae.

Di-*sec.*-octyl tartrate was prepared from ethyl octyl tartrate and octyl alcohol by the hydrochloric acid method. It is an oil which boils at 225° (20 mm.) and has $[\alpha]_D^{18^\circ} = 7{\cdot}06^\circ$. The dibenzoyl derivative was prepared by acting on the ester with excess of benzoyl chloride and was purified by precipitation with water from an alcoholic solution. It is an oil with $[\alpha]_D^{25^\circ} = -43{\cdot}94^\circ$. The rotations of these two compounds are compared with those of other tartaric esters.

134. "Glycogen from yeast." By A. Harden and W. J. Young.

The glycogen of yeast was extracted by grinding the yeast with sand, pouring the mass into boiling water, and purifying the glycogen by a combination of the methods of Clautriau and Pflüger. Expressed yeast juice was employed. The glycogen, free from ash and nitrogen, was compared with glycogen extracted by Pflüger's method from rabbit liver and from oysters.

All three samples, dried at 100° in a vacuum over phosphorus pentoxide, were found to have the composition $C_6H_{10}O_5$ and not $6C_6H_{10}O_5 + H_2O$. Glycogen dried at 100° in air always retained a certain amount of water.

The specific rotations were found to be, rabbit glycogen $[\alpha]_D^{15^\circ} = +191{\cdot}1^\circ$; oyster glycogen $[\alpha]_D^{15^\circ} = +191{\cdot}2^\circ$; yeast glycogen $[\alpha]_D^{16{\cdot}5^\circ} = +198{\cdot}3^\circ$.

In view of the low concentrations of the solutions rendered necessary by their opalescence, this difference cannot be considered as characteristic.

The glycogen from yeast appears to be identical with animal glycogen in composition and optical activity. Slight differences appear to exist in its behaviour towards dilute acids, in the reaction with iodine, and in the opalescence of the aqueous solutions, but these are also exhibited by glycogens derived from various animal sources.

135. "The action of acetylene on the acetates of mercury." By E. Burkard, Ph.D., and M. W. Travers, D.Sc.

The authors have investigated the compounds produced by the action of acetylene on mercurous and mercuric acetates respectively, which were briefly described by the late Dr. R. T. Plimpton (*Proc.*, 1892, 8, 109).

The mercurous compound, which is explosive, has the formula C_2Hg_2,H_2O, and resembles the already well-known acetylides of silver, copper, and mercury.

The mercuric compound appears to be a definite basic acetylide of the formula $3C_2Hg,2HgO,2H_2O$ or $3C_2Hg,2Hg(OH)_2$; it is non-explosive.

Both compounds yield acetylene when treated with acids, and a mixture of di-iodoacetylene and tetraiodoethylene when treated with iodine. Hence it appears that the oxygen and hydrogen in the compounds are connected with the mercury rather than with the carbon.

136. "The decomposition of water vapour by the electric spark." By D. L. Chapman and F. A. Lidbury.

The experiments described show that when electric sparks are passed through water vapour the decomposition which takes place is considerable. The products of decomposition are partly separated from one another and take up different positions in the tube. The separation which occurs cannot be entirely accounted for by electrolysis for the following reasons:

(1) Hydrogen collects at both electrodes and oxygen in the middle of the spark gap.

(2) The hydrogen which collects at the cathode is very largely in excess of that required by Faraday's law.

137. "The chlorination of the dichlorotoluenes in presence of the aluminium-mercury couple. The constitution of the trichlorotoluenes." By J. B. Cohen and H. D. Dakin.

The six dichlorotoluenes were chlorinated, using the aluminium-mercury couple as carrier. In order to identify the products formed, the six trichlorotoluenes were prepared synthetically, together with their nitro- and dinitro-derivatives and the trichlorobenzoic acids which they yield on oxidation. The results show that the six dichlorotoluenes, on chlorination, give five out of the six possible trichlorotoluenes.

138. "The constitution of the nitro- and dinitro-derivatives of the dichlorotoluenes." By J. B. Cohen and H. D. Dakin.

The authors have determined the constitution of the nitro- and dinitro-derivatives of the six dichlorotoluenes which they had previously prepared (*Trans.*, 1901, **79**, 1111). They find that in the case of the mono-substitution derivatives, the chlorine atoms possess a greater influence than the methyl group in determining the position of the entering nitro-group, whilst in the case of the dinitro-compounds the position of the first entering nitro-group appears to be of primary importance in determining the position to be occupied by the second nitro-group, for in all the six dichlorodinitrotoluenes the nitro-groups are in the *meta*-position to one another.

139. "Iodonium compounds of the type IR′R″R‴, and the configuration of the iodine atom." By H. Peters.

Further investigation of the phenyl-*p*-tolyliodonium bromocamphorsulphonate described in a previous note (*Proc.*, 1900, **16**, 62) has confirmed the conclusion that it cannot be resolved into salts of enantiomorphously related bases, from which the inference may be drawn that the three iodine valencies are situated in one plane, two of them being symmetrically situated with respect to the third.

In the preparation of phenyl-*p*-tolyliodonium iodide from iodoso-*p*-toluene and iodoxybenzene, small quantities of *di-*p*-tolyliodonium iodide* are formed owing to secondary reactions; similarly, the crude phenyl-*p*-tolyliodonium iodide, prepared from iodosobenzene and iodoxy-*p*-toluene, contains small quantities of diphenyliodonium iodide. The formation of these subsidiary products is not due to extramolecular change of the radicles of the phenyl-*p*-tolyl salt, and it is shown that the latter is really the salt of a mixed iodonium base.

*Phenyl-*p*-tolyliodonium nitrate*, $Ph(C_6H_4 \cdot Me)I \cdot NO_3$, crystallises in prisms melting at 117°. The *chloride*, $Ph(C_6H_4 \cdot Me)I \cdot Cl$, crystallises in needles and melts at about 193°.

*Di-*p*-tolyliodonium iodide*, $(C_6H_4Me)_2I \cdot I$, forms well-defined, octahedral crystals and decomposes at 143—153°.

*Di-*p*-tolyliodonium bromocamphorsulphonate*, $(C_6H_4Me)_2I \cdot C_{10}H_{14}BrO_4S$, crystallises in needles melting at 185—186°; it is sometimes obtained in hydrated dodecahedra, very like the crystals of the corresponding salt of the mixed base.

Diphenyliodonium bromocamphorsulphonate, $(C_6H_5)_2I \cdot C_{10}H_{14}BrO_4S$, forms hydrated dodecahedra, the anhydrous salt melting at 165—168°.

140. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part II." By G. T. Morgan, D.Sc.

Mixed diazoamines containing a naphthalene nucleus are readily obtained from the diazotised *o*- and *m*-nitranilines and 1·-chloro-β-naphthylamine. The properties and reactions of several are described in detail in the paper.

141. "Observations on the phenomena and products of the decomposition of normal cupric acetate when heated." By A. Angel and A. V. Harcourt.

The authors give a summary of the numerous researches on this subject. One phenomenon which had not been noted previously is the formation of a bright coating of copper in the test-tube in which the salt $[Cu(C_2H_3O_2)_2,H_2O]$ is heated. As this salt does not fuse this must be due to a gaseous compound of copper, proved by the authors to be cuprous acetate, which volatilises at about 200° and forms, especially when sublimed in hydrogen, feathery, white crystals.

The salt was heated generally in a tube in an oil-bath, and kept nearly vacuous by a Sprengel pump and the gases collected. These were found to consist wholly of the oxides of carbon in approximately the ratio $4CO_2 : CO$. The liquid products consisted of water and acetic acid with a trace of acetone. The fixed residue is of a paler or deeper red-brown colour, and consists of metallic copper mixed with a bulky black substance the composition of which may be represented by the formula $C_{11}H_4O_4$.

142. "The resolution of β-hydroxybutyric acid into its optically active components." By A. McKenzie.

In a preliminary note (*Proc.*, 1901, 17, 213), the author mentioned that he had obtained *l*-β-hydroxybutyric acid from the inactive acid by aid of the quinine salt.

The *d*-acid has since been isolated by means of the strychnine salt the solvent being ethyl acetate. It was found that for it $[\alpha]_D^{10^\circ} = +24{\cdot}3^\circ$ $(c = 2{\cdot}226)$.

Change of concentration has little influence on the value for the specific rotation of the acid (Magnus-Levy) and the salts are active in the same sign as that of the acid but to a less degree. In these respects, β-hydroxybutyric acid differs from most other aliphatic oxy-acids.

When the *l*-acid is heated at 100°, it is partly converted into an anhydride.

When the inactive potassium and sodium salts were respectively injected subcutaneously into dogs, the author found from examination of the urine (1) that acetoacetic acid and acetone were present, (2) that a small portion of the β-hydroxybutyrates was unattacked, and (3) that this product was lævorotatory.

Partial resolution of the acid was also obtained by esterification with *l*-menthol and *l*-borneol.

143. "The rate of decomposition of diazo-compounds. Part I. Diazo-compounds of the benzene series." By J. C. Cain and F. Nicoll.

The decomposition of an aqueous solution of a diazo-salt is in most cases a simple monomolecular one, conforming to the expression $C = \frac{1}{t} \log \frac{A}{A-x}$.

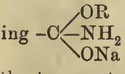
The authors have measured the rate of decomposition of diazo-salts from various bases and find that at temperatures between 20° and 60° the diazo-salts from aniline and the toluidines conform to the above law, thus confirming some results of Hantzsch at 25° (*Ber.*, 1900, **33**, 2517), but being quite opposed to the work of Hausser and Muller at 40° and 64° (*Bull. Soc. chim.*, 1892, [iii], **7**, 721; 1893, **9**, 353).

The authors maintain that the assumption by the latter chemists of a specific "retarding action" of the phenol formed cannot be upheld.

A table of constants of the diazo-salts from eight amines shows the very great stability of the diazo-salts from substances containing an acid group (NO_2 or SO_3H). The diazo-salt from *p*-amidoacetanilide follows the law only in acetic acid solution, as in presence of mineral acid the acetyl group is saponified.

Of the tetrazo-salts of the diamines, only that from dichlorobenzidine follows the law. The others give in the case of the tetrazo-salts from benzidine and tolidine diminishing, and in the case of that from dianisidine, increasing, values for *C*, pointing to the probability of the formation of an intermediate substance containing still a diazo-group.

144. "Studies upon the action of sodamide and acetyl substituted sodamides upon organic esters." By A. W. Titherley, D.Sc., Ph.D.

Sodamide appears to form addition compounds containing the grouping  $-C\begin{cases} OR \\ NH_2 \\ ONa \end{cases}$ when allowed to act on esters in benzene solution if the temperature is kept low. On warming, further action at once takes place, which varies according to the nature of the ester. With esters of benzoic and other purely aromatic acids, an alcohol splits off and a substituted sodamide results.

With esters of fatty and phenyl aliphatic acids, the final result of the reaction is a condensation effected on very similar lines to those brought about by sodium ethoxide, and probably by a similar mechanism.

Phenyl benzoate behaves quite differently from the ethyl ester in giving sodium dibenzamide and phenoxide, and the reaction proceeds with great readiness. Ethyl oxalate gives an intermediate product which with water yields sodium oxamate.

The action of sodamide with ketones is very different in the aliphatic series when condensations are brought about from that in the pure aromatic, where there is no action. Acetone with sodamide gives, in presence of benzene after a vigorous reaction, a jelly consisting essentially of the sodium derivatives of the enolic forms of mesityl oxide, phorone, and isophorone.

The interaction of acyl-substituted sodamides and esters depends largely on the nature of both these substances, which, if aliphatic, induce various complex changes. In the pure aromatic series, a simple definite change occurs which conforms approximately to the reversible system,

$$R{\cdot}CO{\cdot}NHNa + R{\cdot}CO_2R' \rightleftarrows (R{\cdot}CO)_2N{\cdot}Na + R'{\cdot}OH,$$

but in all probability the mechanism of the reverse reaction is more complex.

The reaction is capable of modification in numerous ways, and the acyl-substituted sodamide may be prepared from the amide and alcoholic sodium ethoxide, or (best) from sodamide. A very good yield of dibenzamide is obtainable from sodium benzamide and ethyl benzoate.

Thursday, November 6th, 1902. Professor McLeod, F.R.S., Vice-President, in the Chair.

The Chairman referred to the great loss which the Society had sustained since its last meeting by the deaths of Sir Frederick Abel and Dr. J. H. Gladstone, two of its Past Presidents, who had been for more than fifty years Fellows of the Society.

Messrs. Garle, Hann, Pollitt, Gill, Moore, and Parkes were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

John Frederick Alder, 13, Priestwood Mansions, Highgate, N.
Alfred Edward Beanes, Moatlands, Paddock Wood.
Herbert Blair, No. 3, General Hospital, Kroonstad.
John A. H. Brincker, B.A., M.B., 7, St. Mary's Terrace, Paddington, W.
Vernon Seymour Bryant, B.A., Camborne, Cornwall.
Thomas Burnell Carmichael, Parton, Whitehaven.
Charles Cockle, Peter Symonds School, Winchester.
James Justinian Drought, Johannesberg.
Walter Henry Edwards, The Grammar School, Wellingborough.
Wilfrid Russell Grimwade, B.Sc., Melbourne.
Edward Gumersall, Atbara, Sidcup.
David V. Hollingworth, Aldred House, Crescent, Salford.
Alfred Holt, jun., B.A., Crofton, Aigburth, Liverpool.
Clements F. V. Jackson, A.Inst.C.E., Brisbane.
John Petty Leather, 17, Carlton Road, Burnley.
Frank A. Lidbury, M.Sc., Owens College, Manchester.
Ernest Liotard, 2, Rue de France, Nice.
Thomas Stratford Logan, 52, Kirkgate, Leeds.
Douglas A. MacCallum, Shawlands, Glasgow.
William Mann, B.Sc., Fonnereau Villa, Dartford.
John Marsh, 29, High Street, Maidstone.
Joseph William Mellor, D.Sc., Owens College, Manchester.
John Price Millington, B.A., Christ's College, Cambridge.
John Phelps, B.A., Trinity College, Oxford.
George A. P. Ross, M.B., B.Ch., 20, Westhall Gardens, Edinburgh.
John William Sampson, Helpringham, Heckington.
Duncan Simpson, 10, Brynmill Crescent, Swansea.
Robert Walter Sindall, 80, Manor Road, Brockley, S.E.
John Seabury Smythe, B.Sc., Ph.D., 143, Smithdown Lane, Liverpool.
Walter F. Sutherst, Ph.D., Agricultural College, Holmes Chapel.
George Sutherland Thomson, Government Offices, Adelaide.
Henry Letheby Tidy, B.A., New College, Oxford.
William Carter White, 113, Gower Street, W.C.
Lyndon Wilson, 66, Castle Gate, Newark-on-Trent.

Of the following papers, those marked * were read :

*145. "The specific heats of gases." By H. Crompton.

It was shown that the molecular heat of any gas at the absolute temperature T may be calculated with the help of a formula of the type $A + BT$. In this formula A has the same value for all gases and depends on changes in the movements of the molecules of the gas as a whole. B is proportional to $V \times \log n$, where V is the volume of the molecule and n is the number of atoms in the molecule. BT depends on interatomic changes taking place within the molecule. If for V the molecular volume at the normal boiling point of the liquid Mv_b is taken, the molecular heat at constant pressure $C_p = 4{\cdot}935 + 0{\cdot}000245 Mv_b T \log n$ (or if common logarithms are used the coefficient is 0·000564). The molecular heats calculated from this formula are shown to be in fair agreement with those observed. The ratio k of the two specific heats can also be calculated with the aid of this formula.

DISCUSSION.

Dr. TRAVERS remarked that it would be interesting to know how closely the formula would reproduce the values of the specific heats of the commoner gases, which had been determined with great accuracy and over a considerable range of temperature by Regnault, Witkowski, and others. The agreement between the observed and calculated values in the cases cited by the author was, however, remarkable.

Dr. PHILIP pointed out that the values of C_p given by the two formulæ (Le Chatelier's and that of the author) would, owing to the difference in the numerical constants chosen, be more divergent the lower the temperature. On this account, a study of the applicability of the proposed formula at low temperatures would be specially interesting.

Mr. CROMPTON, in reply, admitted that at low temperatures the results given by the formula did not agree with the observed so well as those obtained at higher temperatures. In explanation of this, he pointed out that the formula was only supposed to hold for an ideal gas, no account being taken of the effect on the specific heat of possible attractions between the molecules. If such attractions existed, they would have a greater influence on the specific heat at low temperatures, and this the nearer the gas was to its point of liquefaction, than under ordinary conditions. No doubt a term should be introduced to allow for the effect of molecular attractions, but at present he was unable to make any suggestion with reference to the character of this correction.

*146. "The action of nitric acid on bromophenolic compounds."

By W. Robertson.

The action of nitric acid on bromophenols and their derivatives was studied in order to determine the conditions under which the bromine atom is replaceable by nitroxyl. It has been found that if the hydrogen of the hydroxyl group be replaced by either the methyl or acetyl radicle, no displacement of bromine by the nitro-group occurs when these substances are acted on by nitric acid under similar conditions. The bromohydroxybenzoic acids and their methoxy- and acetoxy-derivatives were also prepared, and it was found that with regard to them the same rule applied.

The following compounds were described: 2:6-dibromo-4-acetyl aminophenol, needles, m. p. 185—186° (Hölz, *J. pr. Chem.*, 1886, [ii], **32**, 68, gives 173—174°; Friedländer and Stange, *Ber.*, 1893, **26**, 2262, 185°); 2-*nitro*-6-*bromo*-4-*acetylaminophenol*, yellow needles melting at 230°; 2-*nitro*-6-*bromo*-4-*benzoylaminophenol*, yellow needles, m. p. 247°; 2:3:6-*tribromo*-4-*acetylaminophenol*, white needles, m. p. 224° with decomposition; 2:6-dibromo-4-anisidine, white, glistening leaflets, m. p. 66° (Stadel, *Annalen*, 1883, **217**, 70, does not give melting point), and its *acetyl* and *benzoyl* derivatives which crystallise in needles melting at 206° and 180° respectively; *acetyl*-3:5-*dibromosalicylic acid*, m. p. 156°; *acetyl*-5-*bromosalicylic acid*, m. p. 168°; *acetyl*-3:5-*dibromo*-p-*oxybenzoic acid*, m. p. 207°; *ethyl ester* of 3:5-*dibromo*-p-*oxybenzoic acid*, needles, m. p. 99°; *acetyl*-3-*bromo*-p-*oxybenzoic acid*, m. p. 155°; a *dibromo*-m-*oxybenzoic acid*, m. p. 202°; 2-*bromo*-4:6-*dinitro*-3-*oxybenzoic acid*, a yellow substance, m. p. 217—218°.

DISCUSSION.

Mr. W. A. DAVIS pointed out that although Mr. Robertson had been unable to isolate intermediate products of nitration in the case of the bromo-phenols he had dealt with, such substances had been obtained by Armstrong and Rossiter in the form of nitrobromo-keto-naphthalenes (*Proc.*, 1891, **7**, 89). He himself had for several years been working with this class of compounds and had found that their stability depends largely on the proportion of bromine which they contain. Thus, whilst the nitro-keto-compound of β-naphthol is so unstable that it cannot be isolated, and the keto-derivatives of bromo-, dibromo-, and tribromo-β-naphthol are stable only at low temperatures, those formed from the tetrabromo- and pentabromo-naphthols can usually be kept for several days in the dry state without undergoing change. Moreover, whilst the lower brominated keto-compounds are readily reduced to the corresponding bromonitro-naphthols by sodium sulphite, those derived from the tetrabromo-β-naphthols are reducible only by concentrated hydriodic acid.

*147. "3:5-Dichloro-*o*-xylene and 3:5-dichloro-*o*-phthalic acid."

By A. W. Crossley and H. R. Le Sueur.

The high boiling fraction of the liquid obtained by the action of phosphorus pentachloride on dimethyldihydroresorcin, consists of

3 : 5-*dichloro*-o-*xylene*, $C_6(CH_3)_2H_2Cl_2$, which may also be produced by the prolonged heating of dichlorodimethyldihydrobenzene with phosphorus pentachloride. It is a faintly yellow, highly refractive liquid, which boils at 129° (23 mm.) or at 226° (atmospheric pressure), and on cooling solidifies to a mass of flaky needles melting at 3—4°.

On oxidation with nitric acid, it is converted into 3:5-*dichloro*-o-*phthalic acid*, $C_6H_2Cl_2(CO_2H)_2$, which crystallises in hair-like needles melting at 164° with previous contraction and sublimation. The *anhydride* (m. p. 89°) and several other derivatives have been prepared.

*148. "The combination of carbon monoxide with chlorine under the influence of light." By G. Dyson and A. Harden.

Following the method previously described (*Proc.*, 1894, 10, 165), the authors have found:

(1) That when a mixture of carbon monoxide and chlorine, dried by being passed through sulphuric acid, is exposed to light, a well-marked period of photochemical induction occurs.

(2) The induction lapses slowly when the exposed gas is placed in the dark.

(3) The sensitiveness of this mixture to light is greatly diminished by admixture of air, but is not much affected by the presence of carbonyl chloride, hydrogen chloride, excess of carbon monoxide, vapour of carbon tetrachloride, and small amounts of water vapour.

DISCUSSION.

Professor TILDEN said one point which Dr. Harden had omitted to mention was the extent to which the gases had been deprived of moisture. He would be glad to hear by what method they had been dried, and whether the authors had observed that the composition of the glass or the condition of the surface in contact with the gases produced any influence on the rate of their combination.

Dr. HARDEN replied that the gases were dried by being bubbled through strong sulphuric acid. They had not made any experiments specially with reference to the composition of the glass or the condition of its surface.

*149. "The constituents of commercial chrysarobin." By H. A. D. Jowett, D.Sc., and C. E. Potter, B.Sc.

Araroba, or Goa powder, and commercial chrysarobin, the substance obtained from the former by extraction with solvents as chloroform, have been investigated by Attfield, by Liebermann and Seidler, and by Hesse with varying results. The latter chemist found that crude chrysarobin contained no chrysophanic acid, but was a mixture of two parts of chrysarobin, $C_{15}H_{12}O_3$, and one of its methyl ether. He regarded chrysarobin as the anthranole of chrysophanic acid. The authors have examined commercial chrysarobin and find that it contains the following substances, but no chrysophanic acid.

Chrysarobin, $C_{15}H_{12}O_3$, is the anthranole of chrysophanic acid and identical with chrysophanohydroanthrone obtained by the reduction of chrysophanic acid. It melts at 204°. When acetylated with acetic anhydride alone, a mixture of diacetylchrysarobin (m. p. 193°) and triacetylchrysarobin (m. p. 238°) is obtained, but if sodium acetate and acetic anhydride are used, the triacetyl compound is alone produced.

Methyl ether of *dichrysarobin*, $C_{31}H_{26}O_7$, melts at 160°. It yields a soluble pentacetyl compound, m. p. 135°, identical with Hesse's hexacetyldichrysarobin.

Dichrysarobin, $C_{30}H_{24}O_7$, does not melt below 250°, but blackens and chars gradually. On acetylation, hexacetyldichrysarobin (m. p. 179—181°) is obtained. The formula assigned to this constituent is proved by analysis.

A *substance*, $C_{17}H_{14}O_4$, m. p. 181°, which yields an acetyl compound, m. p. 215—216°.

The two latter substances are contained in crude chrysarobin in only small amount, the greater portion consisting of the two first-named substances. Methylchrysarobin was not found to be a constituent of crude chrysarobin. Both chrysarobin and dichrysarobin yield chrysophanic acid on oxidation, and β-methylanthracene by distillation with zinc dust.

Crude chrysophanic acid as obtained from rhubarb contains pure chrysophanic acid, m. p. 190° (acetyl compound, m. p. 206°), and the methyl ether of dichrysarobin, and not the methyl ether of chrysophanic acid as previously stated by Hesse.

*150. "The constituents of an essential oil of rue." By F. B. Power and F. H. Lees.

In order to prepare some methyl nonylketone, the authors obtained a quantity of oil of rue labelled *Ol. Rutae., Ang.*, from an English distiller and found subsequently, on inquiry, that it was not distilled from the native-grown herb. From their results, taken in conjunction with those of Thoms (*Ber. deut. pharm. Ges.*, 1901, **10**, 3) and von Soden and Hexle (*Pharm. Zeit.*, 1901, **46**, 277 and 1026), the authors regard it as most probably of Algerian origin.

The oil was light brown in colour. d 15·5°/16° = 0·8405, $\alpha_D = -3°48'$ for a 100 mm. tube. It was completely soluble in two parts of 70 per cent. alcohol. The following constituents were identified: (1) methyl *n*-heptylketone, b. p. 194·5—195·5° at 763 mm., *d* 14°/16° = 0·8296 (semicarbazone, m. p. 119—120°); (2) methyl *n*-nonylketone, b. p. 231·5—232·5°, *d* 20·5°/16° = 0·8263 (semicarbazone, m. p. 122°); (3) methyl *n*-heptylcarbinol, b. p. 198—200°, *d* 19°/16° = 0·8273, $\alpha_D = -3°44'$ in a 50 mm. tube; *acetate*, b. p. 213—215°, *d* 20·5°/16° = 0·8605, $\alpha_D = -3°3'$ in a 50 mm. tube (oxidation of alcohol to the corresponding ketone, b. p. 195—199°, semicarbazone, m. p. 118—119°); (4) methyl *n*-nonylcarbinol, b. p. 231—233°, $\alpha_D = -1°18'$ in a 25 mm. tube (oxidation to corresponding ketone, oxime, m. p. 46—47°); (5) a blue oil of high but not constant boiling point; (6) acetic acid; (7) a basic substance having the odour of quinoline; (8) a mixture of free fatty acids; (9) methyl salicylate; (10) an ester of valerianic acid, apparently ethyl valerianate; (11) pinene (nitrosochloride, nitrolpiperidide, m. p. 119—120°); (12) *l*-limonene (tetrabromide, m. p. 103°); (13) cineol (compound with tetraiodopyrrol, m. p. 114—115°, and hydrobromide, m. p. 55—56°).

The relative proportions in which the above-mentioned substances were found to exist in the oil are approximately as follows: the two ketones constitute 80 per cent., and were present in about equal amounts. The two alcohols represent about 10 per cent., the methyl *n*-heptylcarbinol preponderating; they were present partly in the free state and partly as acetic esters. The terpenes, together with cineol, amount to about 1 per cent., and the blue oil to about 0·5 per cent. From the non-ketonic portion of the oil, a small amount of an undistillable, viscous substance, probably a decomposition product, was separated.

Since the substances associated with the ketones and alcohols are present in such small amount, and the limonene is the more rarely occurring *l*-form, the authors conclude that all these substances are natural constituents of the oil.

*151. "Methyl β-methylhexyl ketone." By F. H. Lees.

Ethyl sec.-*hexylacetoacetate*, $CH_3 \cdot CO \cdot CH(C_6H_{13}) \cdot CO_2Et$, was prepared by the condensation in alcohol at 100° of ethyl sodioacetoacetate with *sec.*-hexyl iodide; it is a colourless oil which boils at 130—132° (17 mm.), and at 243—245° under atmospheric pressure.

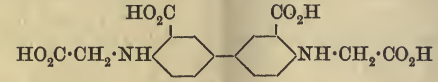
Methyl β-methylhexyl ketone, $CH_3 \cdot CO \cdot CH_2 \cdot CH(CH_3) \cdot (CH_2)_3 \cdot CH_3$, was prepared by the hydrolysis of ethyl *sec.*-hexylacetoacetate with 30 per cent. aqueous potassium hydroxide. It is a colourless oil with a pleasant, fruity odour, boiling at 184° (769 mm.), and having the density *d* 15°/16° = 0·8319. Its *semicarbazone* forms needles and melts at 75°; its *oxime* is a colourless oil.

152: "Di-indigotin." By J. Moir, M.A., D.Sc.

The author's object in the following experiments was to prepare the diphenyl analogue of indigotin, in order to ascertain what influence the doubling of the molecule would have on the colour, since this exercises a marked influence in the case of the benzidine dyes as compared with ordinary azo-dyes derived from aniline. Although successful in preparing the new substance, the yield was so poor and its properties so troublesome to investigate that only a meagre description of it is possible.

The method consisted in applying the synthesis of indigo employed by F. Baeyer & Co. to benzidinedicarboxylic acid instead of to anthranilic acid.

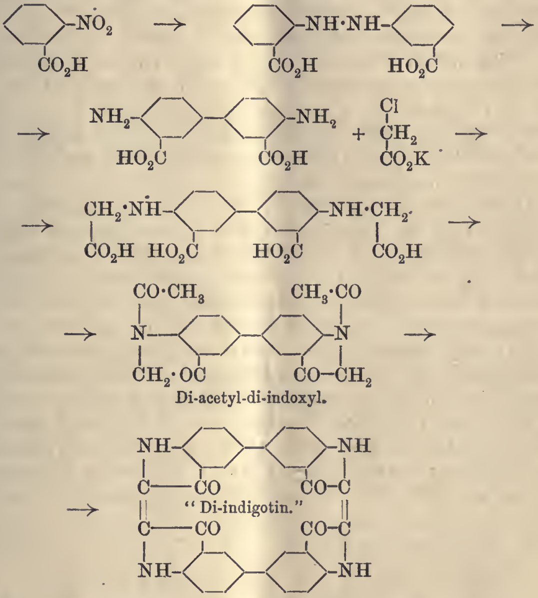
4 : 4′-Benzidine-3 : 3′-dicarboxylic acid was prepared from *o*-nitrobenzoic acid by reduction with sodium hydroxide and aluminium powder until the solution, which was at first dark red, became paler by the conversion of azo- to hydrazo-acid; it was then precipitated with excess of acetic acid, and the hydrazo-acid thus obtained boiled with strong hydrochloric acid to convert it into the benzidine derivative, which was obtained on dilution as an almost insoluble powder, coloured pale green by some oxidation product which could not be removed. It was dissolved in the smallest possible quantity of potassium carbonate solution and mixed with excess of neutral potassium monochloracetate solution. On boiling the mixture for some hours, a small quantity of a crystalline precipitate was obtained, which was filtered off and dried. It melted above 300° and is probably bisphenylglycine-*o*-carboxylic acid,



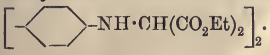
This was boiled during 4 hours with excess of acetic anhydride and dry potassium acetate, and finally taken to dryness on the water-bath. This process closes the indoxyl ring. The product freed from inorganic substances by washing, on digestion with dilute sodium hydroxide, dissolved, the solution becoming green, whilst a pellicle of the di-indigotin formed on the surface. Air was passed into the diluted solution and the olive-green substance was filtered off, washed, and dried. The filtrate was also dark green and gave on acidifying a dark green carboxylic acid, which probably results from the formation of the indoxyl ring at one end only of the first substance.

The properties of the di-indigotin precluded any exact investigation. It is only very slightly soluble in boiling *p*-toluidine, giving a solution distinctly bluer than the original substance as first prepared in fine suspension. It gives an olive-green solution in concentrated sulphuric acid, but is apparently not sulphonated at 100°. It was not analysed, because it was impossible to guarantee its uniformity, but its stability precludes the possibility that it is merely a substituted indigotin.

The following scheme probably represents its formation :



An attempt to confirm this by obtaining the same substance by another synthesis was made. All the methods involving potash fusion failed, but the method of Blank (*Ber.*, 1898, **31**, 1816) was partially successful and is here given as involving the preparation of a new substance. Benzidine was heated with a solution of half its weight of diethyl bromomalonate in chloroform until the odour of the former had gone; the product was boiled out with chloroform and benzene and the filtered extracts concentrated and cautiously treated with ligroin, when the new ester crystallised out in plates. After two recrystallisations from ethyl acetate, it was white and melted sharply at 138°. An analysis showed it to be the expected *ethyl benzidino-dimalonate*,



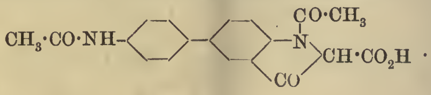
$\left[-C_6H_4-NH\cdot CH(CO_2Et)_2\right]_2$.

0·1564 gave 0·3542 CO_2 and 0·0918 H_2O. $C = 61·73$; $H = 6·52$.
0·2562 „ 12·80 c.c. moist nitrogen at 21° and 759 mm. $N = 5·69$.
$C_{26}H_{32}O_8N_2$ requires $C = 62·40$; $H = 6·40$; $N = 5·60$ per cent.

It forms minute, lustrous plates, sparingly soluble in alcohol and in cold benzene, easily so in hot benzene, ethyl acetate, and chloroform. It is slowly hydrolysed by alkalis, the solution giving, with acids, a flocculent precipitate of the corresponding acid.

On the analogy of Blank's indigo synthesis from ethyl anilinomalonate, the new ester was heated to 200° in an oil-bath until the evolution of vapour ceased. The product was dissolved in a little acetone, filtered, and precipitated by alcohol, giving a dark gum (whilst the alcoholic solution gave a little of the unchanged substance in needles, identified by mixed melting point). On boiling the gum with alcohol, a red resin was left, and the alcoholic solution was concentrated and hydrolysed by sodium hydroxide, giving a deep green solution, but no other evidence of the presence of di-indigotin in solid form. Evidently the action of heat on ethyl benzidinodimalonate is not analogous to its action on ethyl anilinomalonate, for many other temperatures than 200° were tried, but with even less success.

The author has prepared another new substance by boiling benzidine dicarboxylic acid with dry chloracetic acid and dry potassium chloracetate: carbon dioxide was split off, but the product was acetylated as in the former synthesis. A crystalline carboxylic acid (lance-shaped, white crystals, m. p. 292°) was isolated and recrystallised from boiling ethyl acetate. Analysis showed $C = 64·94$; $H = 4·85$; $N = 7·91$ hence the formula $C_{19}H_{16}O_5N_2$, and probably the constitution



153. "Note on the localisation of phosphates in the sugar cane."

By C. H. G. Sprankling.

As very little work has been done with regard to the position of mineral constituents in plants, the author selected the sugar cane as a convenient plant to ascertain the position of the phosphates therein.

Equal portions of three sound canes were thoroughly dried, and after being ground to a fine powder, weighed quantities were ignited, using a slight modification of Fluckiger's method (*Zeit. anal. Chem.*, 1889, **27**, 637).

The ash in each case was extracted with dilute nitric acid, and the final ignited residue taken to be silica; the phosphates in the nitric acid solution were estimated.

From the results of his experiments, the author draws the following conclusions:

(*a*) Phosphates are immediately absorbed by the roots of the plant.

(*b*) These phosphates are rapidly transferred to the upper parts of the plant.

(*c*) A quantity of phosphates is stored in the upper portions and leaves of the cane.

(*d*) The silica is transferred regularly to the leaves, and there stored.

154. "On the non-existence of the gaseous sulphide of carbon described by Deninger." By E. J. Russell and N. Smith.

The authors have examined the gas prepared as Deninger describes (*J. für. Prak. Chemie*, 1895, ii, **51**, 346) and to which he gave the formula CS. Deninger prepared it (1) by heating together in a sealed tube chloroform and sodium sulphide, (2) by subjecting to the same treatment a mixture of iodoform and silver sulphide, (3) by the action of sodium on carbon disulphide mixed with aniline. The authors can find no evidence whatever of the existence of this gas. Sodium and carbon disulphide left in a closed apparatus fitted with a mercury gauge were found to produce no gaseous substance: a mixture of sodium, aniline, and carbon disulphide evolved hydrogen and hydrogen sulphide, and these gases in escaping carried over some carbon disulphide. Evidence that no other gas was present was obtained (1) by analysis, (2) by cooling the mixture and separating it into its constituents.

On heating together in a sealed tube to 180° a mixture of potassium sulphide and chloroform, the products were hydrogen sulphide, hydrogen chloride, chloroform, a reddish-yellow liquid which was apparently an alkyl sulphide, and free sulphur. A mixture of iodoform and silver sulphide similarly treated yielded hydrogen, carbon disulphide, and the reddish-yellow liquid. Although owing to the complex nature of these products the authors can hardly assert that no new gas having the formula CS was present, they could find no indication of any such compound.

155. "Hydroxyoxamides. Part II." By R. H. Pickard, C. Allen W. A. Bowdler, and W. Carter.

The authors described the following new hydroxyoxamides, namely: *o*-, *m*-, and *p*-nitrophenyl-, *o*-tolyl-, and ethyl-hydroxyoxamides. These react as hydroxamic acids (*Trans.*, 1901, **79**, 841). The esters of hydroxyoxamides are weak acids, and the hydroxyoxamides react with phenylhydrazine, forming phenylhydrazides. These and other reactions show that the hydroxyoxamides behave like typical hydroxamic acids, and are therefore constituted according to the formula R·NH·CO·C(OH)∶NOH and not R·NH·C∶(NOH)·CO_2H, as suggested by Schiff (*Annalen*, 1902, **321**, 357) and Holleman (*Rec. trav. chim.*, 1896, **15**, 148).

156. "Isometric anhydrous sulphates of the form $M''SO_4,R_2'SO_4$." By F. R. Mallet.

The author described the anhydrous salts $MgSO_4,K_2SO_4$, $MgSO_4,Rb_2SO_4$, $MnSO_4,K_2SO_4$, $MnSO_4,Rb_2SO_4$, $MnSO_4,Tl_2SO_4$, $NiSO_4,K_2SO_4$, and $CoSO_4,K_2SO_4$, which all crystallise in tetrahedral forms, being allied in this respect to the sulphates $2M''SO_4,R_2'SO_4$ previously described (*Trans.*, 1900, **77**, 216). They vary in their stability when exposed to the air, some remaining unaltered, whilst others are converted somewhat rapidly into the hexahydrated salts, $M''SO_4,R_2'SO_4,6H_2O$.

157. "The catalytic racemisation of amygdalin." By J. W. Walker.

Much more amygdalin is dissolved by water containing a small quantity of alkali, of alkaline earth, or of alkali carbonate, than by pure water. From polarimetric determinations of the rate of hydrolysis of the various substances involved, the author concludes that in alkaline solution the glucoside is racemised by the catalytic action of the hydroxyl ions, and that amygdalinic acid is racemoid with respect to its asymmetric carbon atom.

158. "On asymmetric optically active selenium compounds and on the sexavalency of selenium and sulphur." By W. J. Pope, F.R.S., and A. Neville, B.Sc.

Methylphenyl selenide, $C_6H_5·Se·CH_3$, the first mixed alkyl selenide which has been described, is obtained as a pale yellow oil boiling at 200—201° by the action of methyl iodide on the sodiophenyl selenide of Krafft and Lyons. Owing, apparently, to the highly basic character of selenium, it differs markedly from methylphenyl sulphide in that it combines readily with bromacetic acid to form the asymmetric *methylphenylselenetine bromide*, $\begin{matrix}CH_3\\C_6H_5\end{matrix}{>}Se{<}\begin{matrix}Br\\CH_2·CO_2H\end{matrix}$; this salt crystallises in colourless scales melting at 111° and on treatment with silver *d*-bromocamphorsulphonate, yields a mixture of the two following salts, which may be separated by crystallisation from alcohol.

d-*Methylphenylselenetine* d-*bromocamphorsulphonate* (*d-B*, *d-A*), $Se(CH_3)(C_6H_5)(CH_2·CO_2H)·C_{10}H_{14}BrOSO_3$, is the less readily soluble and forms needles melting at 168°; in aqueous solution, its rotations are $[\alpha]_D = +61 \cdot 26°$ and $[M]_D = +330 \cdot 8°$.

l-*Methylphenylselenetine* d-*bromocamphorsulphonate* (*l-B*, *d-A*), is much more soluble than the preceding salt, and is obtained in minute, white scales melting at 151°. Its rotations in aqueous solution are $[\alpha]_D = +38 \cdot 81°$ and $[M]_D = +209 \cdot 6°$. Since the *d*-bromocamphorsulphonic ion has the molecular rotation $[M]_D = +270°$, the corresponding value for the optically active selenetine ion is $[M]_D = \pm 60 \cdot 6°$.

The *dextro-* and *lævo-methylphenylselenetine platinichlorides*, $[Se(CH_3)(C_6H_5)(CH_2 \cdot CO_2H)Cl]_2PtCl_4$, form yellow prisms melting at 171°; they have the molecular rotations $[M]_D = +55 \cdot 0°$ and $-54 \cdot 3°$ respectively in acetone solution.

The same optically inactive *methylphenylselenetine mercuriodide*, $Se(CH_3)(C_6H_5)(CH_2 \cdot CO_2H)I,HgI_2$, is obtained by precipitating either of the salts (*d-B*, *d-A*), (*l-B*, *d-A*), or methylphenylselenetine bromide with a solution of potassium mercuric iodide; the mercuriodide forms white scales melting at 141—142°. The optical inactivity of this salt being remarkable, in view of the fact that the *d*- and *l*-benzylphenylallylmethylammonium ions preserve their optical activity during formation of the mercuriodides, it seemed desirable to ascertain if the same behaviour was exhibited during the formation of a mercuriodide from an optically active thetine.

The authors therefore prepared the optically active methylethylphenacylthetine salts of Smiles instead of the methylethylthetine compounds previously described by Pope and Peachey, owing to the greater optical rotations exhibited by the optically active ions of the former substances. It was then found that the *d*-methylethylphenacylthetine *d*-bromocamphorsulphonate, (*d-B*, *d-A*), had the molecular rotation $[M]_D = +332 \cdot 8°$, whilst the corresponding salt, (*l-B*, *d-A*), gave $[M]_D = +210 \cdot 6°$; the optically active methylethylphenacylthetine ion therefore has the molecular rotation $[M]_D = \pm 61 \cdot 1°$, a value about three times as great as $[M]_D = \pm 19 \cdot 4°$, the molecular rotation deduced from Smiles' determinations.

Each of the above salts yields the same optically inactive *mercuriodide*, $S(CH_3)(C_2H_5)(CH_2 \cdot CO \cdot C_6H_5)I,HgI_2$, melting at 128°, and *mercurichloride*, $S(CH_3)(C_2H_5)(CH_2 \cdot CO \cdot C_6H_5)Cl,HgCl_2$, melting at 119°. They also give the same *methylethylphenacylthetine*-d-*mercuribromocamphorsulphonate*, $S(CH_3)(C_2H_5)(CH_2 \cdot CO_2 \cdot C_6H_5)C_{10}H_{14}BrOSO_3,Hg(C_{10}H_{14}BrOSO_3)_2$, which has a molecular rotation $[M]_D = +799°$, very nearly three times that of the *d*-bromocamphorsulphonic ion, and in which the sulphur atom does not seem to act as a centre of optical activity.

The authors conclude that the mercuri-compounds of the sulphonium and selenonium bases probably contain sexavalent sulphur and selenium.

159. "The transformation of acetylchloroaminobenzenes into the isomeric chloroacetanilides." By F. D. Chattaway and K. J. P. Orton.

Owing to the recent publication by Blanksma (*Proc. K. Akad. Wetensch. Amsterdam*, 1902, p. 178) of measurements of the velocity of transformation of acetylchloroaminobenzene into *p*-chloroacetanilide, the authors wish to record the results of some preliminary experiments made by them two years ago (September, 1900) on isomeric changes of this type. These experiments were not published at that time, as Armstrong had previously stated (*Trans.*, 1900, 77, 1053) that he was engaged on a similar investigation.

To follow the course of the isomeric change, a 1 per cent. solution of the chloramine in glacial acetic acid or in 50 per cent. acetic acid was kept at a constant temperature in the dark, and the amount transformed estimated at intervals by titrating the iodine liberated from hydriodic acid by the unchanged substance. In the presence of an acid, such as hydrochloric or sulphuric, the isomeric chloroacetanilide is produced. When hydrochloric acid is added, the change starts at once and proceeds regularly; with sulphuric acid, on the other hand, no transformation occurs at first, but after a short interval it begins and proceeds at a constantly increasing rate. At any period, however, during which isomeric change is taking place, hydrogen chloride can be recognised in the solution. The results of the authors confirm the observation first made by Armstrong (*loc. cit.*), that hydrochloric acid has a specific action in the transformation of phenylchloramines.

The experiments were carried out mainly with acetylchloroamino-*p*-chlorobenzene, $C_6H_4Cl{\cdot}NCl{\cdot}Ac$, not only because this substance is obtained somewhat more easily in a pure state, but especially because it changes more slowly into the isomeric anilide than does acetylchloroaminobenzene.

The value of the velocity coefficient, calculated from the equation $k = 1/t \log a/(a-x)$, increases with the amount of the catalytic agent and with the temperature, but decreases when the proportion of water in the solvent is increased. In any given experiment, it also begins to increase at some point in the course of the reaction, usually after the first 50 per cent. of the chloramine has changed.

The following experiment shows the kind of results obtained: A 1 per cent. solution of acetylchloroamino-*p*-chlorobenzene in glacial acetic acid containing 0·023 per cent. hydrogen chloride was kept at a temperature of 16·5°, and the unchanged chloramine estimated at the end of 1, 2, 4, 6, 8, 24, and 28 hours. Calculating the velocity coefficient from the above equation, the values obtained are respectively 0·0100, 0·0104, 0·0106, 0·0105, 0·0107, 0·0109, and 0·0110; the mean value is 0·0106.

In a series of experiments carrried out in order to ascertain the effect of temperature and of variation in the percentage of hydrogen chloride present, and in the concentration of the acetic acid, the following results were obtained. Using a 1 per cent. solution in glacial acetic acid containing 0·023 per cent. hydrogen chloride, half the chloramine was transformed in 27·4 hours; but in the presence of 0·069 per cent. hydrogen chloride, half was transformed in 5·33 hours, the temperature in each case being 16·5°. With a 1 per cent. solution containing 0·023 per cent. hydrogen chloride, at a temperature of 35·9°, half was transformed in 2·75 hours; the value of the velocity-coefficient in this case was not constant, but rapidly increased. Using 50 per cent. acetic acid containing 0·023 per cent. hydrogen chloride as the solvent, 120 hours elapsed before half was transformed at a temperature of 16·5°.

With 0·9 per cent. sulphuric acid, instead of hydrogen chloride, in glacial acetic acid, at a temperature of 16·5°, no appreciable change occurred in 2 hours; but after 24 hours 8·9 per cent., and after 84 hours 50 per cent., had changed. Hydrochloric acid, which could not be recognised in the solution after 2 hours, was found to be present after 24 hours.

Similar experiments made with acetylchloroaminobenzene, PhNCl·Ac, show that the isomeric change takes place at a greater rate when the chlorine can wander into the para-position than when it can only pass into the ortho-positions. Thus, in an experiment similar to those just described (HCl = 0·023 per cent.), the time required for the transformation of half the chloramine was 2 hours instead of 27·4 hours.

In connection with the transformation of phenylacylchloramines under the influence of hydrogen chloride, the following facts are worthy of note. When kept in the dark at the ordinary temperature, the titer of a solution in glacial acetic acid of acetylchloroamino-2 : 4-dichlorobenzene, which under these conditions cannot be transformed into the isomeric *s*-trichloroacetanilide, slowly falls, and at the same time a vapour (probably hypochlorous acid) is given off, which sets free iodine from potassium iodide. (A similar vapour is evolved from solution of any chloramine in glacial acetic acid.) If small quantities of hydrogen chloride or sulphuric acid be present, the titer decreases more rapidly; thus with a solution of the last-mentioned chloramine containing 0·069 per cent. of hydrogen chloride, the titer fell 23 per cent. at 16·5° in eight days, whilst in the presence of 0·36 per cent. sulphuric acid the titer fell 8 per cent. of the initial amount in the same period. In both cases the solutions, which were kept in the dark, acquired a yellow colour. Possibly these changes are due to the hydrolysis of the chloramine; the acetic acid contained 1·8 per cent. of water.

Further, when a solution of hydrogen chloride in dry petroleum is added to a solution of acetylchloroamino-*p*-chlorobenzene in the same solvent, *p*-chloroacetanilide, which is insoluble in petroleum, immediately separates.

Blanksma (*loc. cit.*) has drawn attention to the action of light in effecting this isomeric change, and has observed the transformation of the solid substances under its influence. On exposing any chloramine dissolved in chloroform or in acetic acid to sunlight, the originally colourless solution in a few minutes becomes yellow and acquires a chlorous smell; in all cases the solution then gives a precipitate with silver nitrate. If a phenylacylchloramine, which is capable of isomeric change, is so treated, transformation follows. Thus after two hours' exposure to sunlight, acetylchloroamino-*p*-chlorobenzene is changed into the isomeric anilide to the extent of 31 per cent. when dissolved in chloroform, but only to the extent of 12 per cent. when dissolved in acetic acid. The light is probably active by virtue of the fact that it induces decomposition, in the course of which the catalytic agent is formed.

These results show that in the presence of hydrogen chloride the transformation of phenylacylchloramines into chloroanilide is *apparently* a monomolecular reaction, and in this way resembles other similar isomeric changes; but it must not be forgotten that in measuring the speed of a chemical reaction the velocity of the slowest of the series of simple changes which constitute the complete transformation is alone measured.

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III. Pamphlets.

Agricultural Students' Gazette. Vol. x, part 2, Dec., 1900; and vol. x, part 6, April, 1902. From Professor Kinch.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 8th.

At the next meeting, on **Wednesday**, November 19th, at **5.30** p.m., the following papers will be communicated:

"The dynamic isomerism of thiourea and ammonium thiocyanate." By J. E. Reynolds and E. A. Werner.

"Isomeric partially racemic salts containing quinquevalent nitrogen. Part VIII. Resolution of the hydrindamine bromocamphor sulphonates." By F. S. Kipping.

"Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

"The synthesis of *aa*-dimethylglutaric acid, of β-hydroxy-*aa*-dimethylglutaric acid, and of the *cis*- and *trans*-modifications of *aa*-dimethylglutaconic acid." By W. H. Perkin, jun., and Miss E. Smith.

"A reaction of some phenolic colouring matters. Part II." By A. G. Perkin and C. R. Wilson.

"The vapour pressures and boiling points of mixed liquids. Part II." By S. Young and Miss E. C. Fortey.

"The vapour pressures and boiling points of mixed liquids. Part III." By S. Young.

"Note on mixtures of constant boiling point." By S. Young.

"Note on the condensation points of the thorium and radium emanations." By E. Rutherford and F. Soddy.

"The oxime of mesoxamide and some allied compounds. Part II. Disubstituted derivatives." By Miss M. A. Whiteley.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 256.

Wednesday, November 19th, 1902. Professor EMERSON REYNOLDS, Sc.D., V.P.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Gilbert John Alderton, Eglinton Road, Plumstead, S.E.
Harry Percy Lewis, Swansea Hematite Works, Landore.
Thomas Samuel, School of Science and Art, Liscard, Cheshire.
John Mello Wadmore, B.A., Meriden, Exmouth.
Albert Wilmore, 158, Skipton Road, Colne.
William Wade Yeomans, Middlewich, Cheshire.

The PRESIDENT announced that the Council that afternoon had appointed Dr. G. T. Morgan to be Editor of the publications of the Society from January 1st next.

Of the following papers, those marked * were read:

*160. "The 'dynamic isomerism' of thiourea and ammonium thiocyanate." By J. E. Reynolds, D.Sc., F.R.S., and E. A. Werner, F.I.C.

The method of producing thiourea for use in the arts is still essentially that by which one of the authors succeeded in isolating the substance in 1868 (*Trans.*, 7, 1). This consists in carefully heating fused ammonium thiocyanate so as to secure as far as possible the molecular rearrangement represented by $NH_4CNS = CSN_2H_4$.

The proportion of thiourea actually formed at any *single* operation of this kind is known to be small. Volhard and others have variously estimated the yield at 15 to 22 per cent. of the thiocyanate taken for conversion. It is also well known that pure thiourea, when melted, slowly reverts to ammonium thiocyanate; but the estimates of the extent of this reversion also vary considerably. Viewed as a "balanced action" conditioned by heat alone, these changes are cited by Lowry as examples of "dynamic isomerism."

In view of these discrepancies which they considered were probably due to the use of small quantities of impure or moist materials, the authors have systematically studied on a comparatively large scale the effects of temperature and time on the course of these changes, and give the results of their experiments in curves. They show that:

1. Ammonium thiocyanate fused and then raised to, and maintained at, a steady temperature of 170°, underwent gradual change into thiourea until a maximum of 24·7 per cent. was reached after 45 minutes. Continued heating for 25 minutes longer led to slight *loss* of thiourea by decomposition.

2. In another series of experiments, the mean temperature being 182°, similar results were obtained, but the change was more rapid in the earlier stages, although the time required for the maximum effect was substantially the same as before.

3. Pure thiourea fused, and then maintained at a steady temperature of 170°, gradually reverted to ammonium thiocyanate, and after 40 minutes only 25·8 per cent. of thiourea remained. That proportion was not materially diminished by continued heating.

Therefore equilibrium is reached from either side when the isomerides are present in the melt in proportions which are substantially 25 per cent. of thiourea and 75 per cent. of ammonium thiocyanate, which is the composition of a definite compound having the formula $CSN_2H_4,(NH_4CNS)_3$.

The authors conclude that the arrest of change is due to the production of this compound which appears to be more stable at high temperatures than either of its constituents.

In confirmation of this view, they find that crystalline aggregates of nearly the above composition can be separated from the centre of a slowly cooled mass, produced by heating about a kilogram of ammonium thiocyanate to 170° for 40 minutes.

Further, having noted that the material which contained about 25 per cent. of thiourea remained liquid down to 106°, they determined the points of complete liquefaction of a number of very intimate mixtures of pure thiourea and thiocyanate. They found that there was a regular decrease in melting point from 148° (that of pure thiocyanate) to 106°, at which latter temperature a mixture containing 25 per cent. of thiourea fused, but with still higher percentages of thiourea there was a regular *rise* in melting point, as shown on a curve of eutectic form having its minor point at 106°.

Finally, it was pointed out that the dissociation of the high temperature compound by solvents is by no means complete unless the latter are used in comparatively large proportions.. Thus, when the melt was treated with insufficient warm acetone to dissolve it wholly, the solution afforded a compound which afterwards separated in feathery groups of crystals. This substance proved on analysis to be CSN_2H_4,NH_4CNS. With alcohol and water, the process of breaking down proceeds farther, but even warm water, if used in small proportion, does not cause complete separation, as fine, long crystals were easily obtained from such a solution which consisted of $(CSN_2H_4)_3,NH_4CNS$.

This compound is obviously complementary in composition to that which is formed in the fused mass at 170°. Re-solution of the crystals in water leads to complete separation.

Generally, the authors conclude that the state of equilibrium reached when either isomeride is heated to 170° for 40 minutes is conditioned as much by perfectly definite chemical attraction as by heat.

*161. "Isomeric partially racemic salts containing quinquevalent nitrogen. Part VIII. Resolution of the hydrindamine bromocamphorsulphonates." By F. S. Kipping.

In previous communications (*Trans.*, 1900, **77**, 861 ; 1901, **79**, 430), the author has described several cases of a new type of isomerism observed in the study of salts of *dl*-hydrindamine (and of *dl*-benzylhydrindamine) with bromo- and chloro-camphorsulphonic acids and with *cis*-π-camphanic acid; in order to account for the existence of these isomerides, it was assumed that each of the optically active bases gives rise to *two* salts, and that the four compounds thus formed unite in pairs to produce the two partially racemic isomerides.

Further investigation, which so far has been restricted to the isomeric hydrindamine bromocamphorsulphonates (distinguished as the 'α'- and 'β'-salts), seems to show that this view of their nature is substantially correct.

Resolution of the α-Salt.—When the α-salt (m. p. 150°), which separates unchanged from most ordinary solvents, is heated with a little ethyl acetate under suitable conditions, it is resolved into two components, one of which is deposited from the hot solution, whilst the other can be isolated from the mother liquors. The former, provisionally called the αA-salt, crystallises in needles melting at about 223°; the latter, the αB-salt, crystallises in needles melting at about 130°.

These two salts have practically the same specific rotation in dilute aqueous solution, namely, $[\alpha]_D = +60°$; the molecular rotation, therefore, in both cases is +266°, a value identical with that of bromocamphorsulphonic acid. The two compounds represent, nevertheless, salts of the enantiomorphously related hydrindamines, the bases having such low molecular rotations that they show no appreciable activity, even in moderately concentrated solutions of their hydrochlorides. The hydrochlorides, prepared from the αA- and αB-salts, are identical in ordinary properties, but the salts obtained by combining the bases from αA and αB with optically active acids are different; it follows, therefore, that the enantiomorphously related bases do not undergo racemisation when liberated from their salts.

Resolution of the β-Salt.—The partially racemic β-salt (m. p. 130°) is also resolved into different components when it is crystallised from hot ethyl acetate under suitable conditions. The salt, which separates from the hot solution, crystallises in needles which appear homogeneous and which resemble αA very closely in outward and in optical properties; when, however, this compound is systematically crystallised from water, after some 30—40 operations, it is further resolved into a salt identical with αA and a new isomeride βA; the latter is very similar to αA, but melts at a lower temperature (about 215°), and has a lower specific rotation ($[\alpha]_D = +56°$) in aqueous solution; it is possible that this salt may not have been obtained quite free from αA.

The ethyl acetate mother liquors, from which αA and βA have been deposited, contain unchanged β-salt together with two isomerides; one of these is identical with αB, but the other, βB, although very similar to αB in some properties, can be separated from it by fractional crystallisation from water. This fourth isomeride, βB, melts at about 130° and has a specific rotation $[\alpha]_D = +39{\cdot}5°$ in aqueous solution.

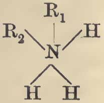
Synthesis of the α- and β-Salts:—When equal quantities of αA and αB are dissolved together in hot water, the solution deposits the partially racemic α-salt, and fractional crystallisation fails to reveal the presence of any β-salt in the product.

When αA and αB are separately decomposed with baryta and the liberated bases are neutralised with the bromo-acid, the salts obtained appear to be identical with αA and αB respectively, but they are not so; for if now mixed in equal quantities and crystallised from water they give a product which consists of a mixture of the α- and β-partially racemic salts. This is because, on uniting with the acid, the one base gives αA and βA, the other αB and βB; the salt produced by combining the base from αB with the acid may, in fact, be resolved into αB and βB by fractional crystallisation.

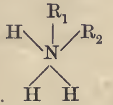
When equal quantities of βA and βB are dissolved together in water, there results a salt which crystallises in hydrated prisms, indistinguishable in appearance from those of the partially racemic β-salt (m. p. 130°), but which, when dehydrated, melts at about 165°; this fact, and the constant occurrence of four compounds in the products of the resolution of samples of the β-salt which have been repeatedly crystallised to free them from α-salt, show that the β-salt is composed of *four* isomerides. The salt composed of equal quantities of βA and βB seems to represent a new isomeride, in which case there would be three partially racemic salts.

*162. "Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

From the results summarised in the preceding note, it will be seen that *six* isomeric salts have now been isolated from the mixture produced by the combination of *dl*-hydrindamine and *d*-bromocamphorsulphonic acid. Four of these salts, αA, αB, βA, and βB contain one molecule of one of the enantiomorphously related bases combined with one molecule of the acid, that is to say, each of the bases gives rise to two isomerides which may be represented by the symbols:



and



Such compounds, containing only *three* different radicles united with quinquevalent nitrogen, afford an example of a type of isomerism hitherto unknown; it is possible, however, that the isomerism of the optically inactive compounds of the type $NR_1R_2R_3R_4R_5$, described by Wedekind, may be of an analogous character.

The existence of these new isomerides has no doubt an important bearing on the question of the arrangement in space of the groups around a quinquevalent atom, and would seem to exclude the double tetrahedron configuration; also the view, very generally held, that the negative ion in an ammonium salt takes up one particular valency. The fact that, in the case examined, the two radicles R_1 and R_2 are enantiomorphous does not of course preclude the possibility of the existence of isomerides in which the three different radicles are all optically inactive, and it may even be possible that an apparently simple salt, such as ammonium chloride, is in reality a mixture of two isomerides.

One particularly striking fact in connection with the isomeric hydrindamine salts is their stability; all the four simple isomerides have been repeatedly crystallised from boiling water and other solvents, and hitherto the conversion of one into the other has never been observed.

It is also interesting to note the highly abnormal molecular rotation of the βB-isomeride; in 2 per cent. aqueous solution, $[M]_D = +175°$, whereas that of the acid is $[M]_D = +270°$. Since the ordinary base ion, although enantiomorphous, has only an extremely low molecular rotation, it might be inferred that the βB-isomeride is only very partially dissociated, and that there are two distinct types of ammonium salts.

*163 "The oxime of mesoxamide and some allied compounds. Part II. Disubstituted derivatives." By Miss M. A. Whiteley, D.Sc.

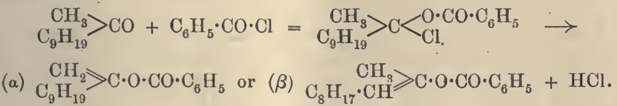
The following mono- and di-substituted derivatives of the oxime of mesoxamide have been prepared: iso*nitrosomalondimethylamide*, m. p. 157°, the *potassium* and *ferrous* salts; iso*nitrosomalonanilide*, m. p. 141°, the *potassium*, *ferrous*, and *silver* salts; iso*nitrosomalondi*-p-*tolylamide*, m. p. 170—171°, the *potassium* and *silver* salts; iso*nitrosomalonmono*-p-*tolylamide*, m. p. 183°; iso*nitrosomalondi*-o-*tolylamide*, m. p. 111°, the *potassium* salt; *ethyl* iso*nitrosomalon*-o-*tolylamate*, m. p. 140—141°; iso*nitrosomalondi-α-naphthylamide*, m. p. 184°, the *potassium* salt; iso*nitrosomalondi-β-naphthylamide*, m. p. 221°, the *acetyl* derivative, m. p. 179°, a chlorinated derivative, m. p. 202°.

All these compounds possess the characteristic salt-forming properties exhibited by the original oxime, the alkali salts being yellow and the ferrous salts purple or blue. An interesting tautomerism is exhibited by some of them, the two isomerides differing from one another in colour (one being yellow and the other colourless), crystalline form, and solubility. The most probable explanation of this tautomerism is the assumption that the colourless isomeride has the *iso*oximino-structure, whilst the yellow isomeride and the yellow salts correspond to the oximino-compound.

The examination of a fairly extensive series of α-oximino-ketones has shown that in addition to the well known characteristic yellow coloration with alkalis, almost all give a deep purple or blue colour on the further addition of ferrous sulphate. This latter characteristic, however, appears to be influenced by the isomerism of the oximino-group, for α-benzil monoxime gives the reaction, whilst the β-isomeride does not. Again, among the dioximes, a considerable number, including α-benzil dioxime, were found to give a deep purple or brown coloration with ferrous sulphate and an alkali, whilst β- and γ-benzil dioxime gave no coloration under these conditions.

*164. "Interaction of ketones and aldehydes with acid chlorides—the formation of benzoxyolefines and 1-benzoxycamphene." By F. H. Lees.

The author has found that methyl *n*-nonylketone and benzoyl chloride readily interact when boiled together, forming *β-benzoxyundecylene* (α or β), $CH_2{:}C(OBz){\cdot}C_9H_{19}$ or $CH_3{\cdot}C(OBz){:}CH{\cdot}C_8H_{17}$. It is an oil, b. p. 233—235° (50 mm.), and is regarded as being formed according to the scheme:

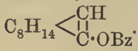


$$\begin{matrix}CH_3\\C_9H_{19}\end{matrix}\!>\!CO + C_6H_5{\cdot}CO{\cdot}Cl = \begin{matrix}CH_3\\C_9H_{19}\end{matrix}\!>\!C\!<\!\begin{matrix}O{\cdot}CO{\cdot}C_6H_5\\Cl.\end{matrix} \longrightarrow$$

$$(\alpha)\ \begin{matrix}CH_2\\C_9H_{19}\end{matrix}\!\geqslant\!C{\cdot}O{\cdot}CO{\cdot}C_6H_5 \text{ or } (\beta)\ \begin{matrix}CH_3\\C_8H_{17}{\cdot}CH\end{matrix}\!\geqslant\!C{\cdot}O{\cdot}CO{\cdot}C_6H_5 + HCl.$$

This formation of β-benzoxyundecylene represents the first instance of the direct transformation of a mono-oxygenated ketone into a derivative of its enolic form. The author has extended this reaction to other ketones, an aldehyde, and an aliphatic acid chloride, the following substances resulting: *β-benzoxynonylene* (α or β), $CH_2{:}C(OBz){\cdot}C_7H_{15}$ or $CH_3{\cdot}C(OBz){:}CH{\cdot}C_6H_{13}$, from methyl *n*-heptylketone and benzoyl chloride, b. p. 210—211° (50 mm.); *β-benzoxy-γ-methylheptylene* (α or β), $CH_2{:}C(OBz){\cdot}CH(CH_3){\cdot}C_4H_9$ or $CH_3{\cdot}C(OBz){:}C(CH_3){\cdot}C_4H_9$, from methyl *sec.*-hexylketone and benzoyl chloride, b. p. 197—200° (50 mm.); *β-benzoxyhexylene* (α or β), $CH_2{:}C(OBz){\cdot}C_4H_9$ or $CH_3{\cdot}C(OBz){:}CH{\cdot}C_3H_7$, from methyl *n*-butylketone and benzoyl chloride, b. p. 170—175° (50 mm.); *α-benzoxy-α-phenylethylene*, $C_6H_5{\cdot}C(OBz){:}CH_2$, from acetophenone and benzoyl chloride, b. p. 227—230° (50 mm.); 1*-benzoxycamphene*, $C_8H_{14}\!<\!\begin{matrix}CH\\ \| \\C{\cdot}OBz\end{matrix}$, from camphor and benzoyl chloride, b. p. 215—220° (50 mm.); *α-benzoxy-α-heptylene*, $C_5H_{11}{\cdot}CH{:}CH(OBz)$, from œnanthaldehyde and benzoyl chloride, b. p. 195° (50 mm.); *β-valeroxyundecylene* (α or β), $CH_2{:}C(O{\cdot}CO{\cdot}C_4H_9){\cdot}C_9H_{19}$ or $CH_3{\cdot}C(O{\cdot}CO{\cdot}C_4H_9){:}CH{\cdot}C_8H_{17}$, from methyl *n*-nonylketone and valeryl chloride, b. p. 185—190° (50 mm.).

Acetone with benzoyl chloride, and methyl nonylketone with acetyl chloride, did not interact; methyl *n*-propylketone and benzoyl chloride interacted only slightly. All the substances prepared are nearly colourless and odourless oils, and in their chemical properties exactly resemble each other. They all readily absorb bromine, forming dibromo-addition products, and are unstable to potassium permanganate. The possibility of benzoxycamphene having a structure analogous to hydroxycamphene (Forster, *Trans.*, 1902, 81, 264) was considered, but the fact that benzoxycamphene is readily hydrolysed by alcoholic hydroxylamine, yielding *l*-rotatory camphoroxime, and that its dibromo-addition product readily splits up into α-bromocamphor and benzoyl bromide, definitely proves the correctness of the structure



$C_8H_{14}<\begin{array}{l}CH\\ \|\\ C\cdot OBz\end{array}$.

65. "The synthesis of *αα*-dimethylglutaric acid, of *β*-hydroxy-*αα*-dimethylglutaric acid, and of the *cis*- and *trans*-modifications of *αα*-dimethylglutaconic acid." By W. H. Perkin, jun., and Miss A. E. Smith.

When a mixture of ethyl dimethylmalonate and ethyl acetate is treated with sodium, condensation readily takes place with the formation of ethyl *αα*-dimethylacetonedicarboxylate, $CO_2Et\cdot CMe_2\cdot CO\cdot CH_2\cdot CO_2Et$, which distils at 185—190° (100 mm.) and gives, in alcoholic solution with ferric chloride, a red-violet coloration. When this ester is reduced with sodium amalgam and then with hydriodic acid, it yields the following acids :-

β-Hydroxy-αα-dimethylglutaric acid, $CO_2H\cdot CMe_2\cdot CH(OH)\cdot CH_2\cdot CO_2H$, which crystallises from water in prisms and melts at 158—160°.

αα-Dimethylglutaric acid, $CO_2H\cdot CMe_2\cdot CH_2\cdot CH_2\cdot CO_2H$, which melts at 90° and is identical with the acid of this constitution obtained from *iso*lauronolic acid by oxidation with nitric acid.

cis-*αα*$_1$-*Dimethylglutaconic acid*, $CO_2H\cdot CMe_2\cdot CH{:}CH\cdot CO_2H$. This acid is readily soluble in water and melts at 134°; it combines with bromine yielding cis-*α*$_1$*β-dibromo-αα-dimethylglutaric acid* (m. p. 150°). When hydroxydimethylglutaric acid is distilled, it is, in part, converted into the sparingly soluble *trans*-*αα*$_1$-dimethylglutaconic acid which melts at 172° and was first obtained (Perkin, *Trans.*, 1902, 81, 253) by the hydrolysis of ethyl *α*$_1$-bromo-*αα*-dimethylglutarate, $CO_2Et\cdot CMe_2\cdot CH_2\cdot CHBr\cdot CO_2Et$, with alcoholic potash. This same acid is obtained almost quantitatively from the above hydroxy-acid by treatment with phosphorus pentachloride, then with alcohol, and finally with alcoholic potash, $CO_2Et\cdot CMe_2\cdot CHCl\cdot CH_2\cdot CO_2Et$, giving $CO_2H\cdot CMe_2\cdot CH{:}CH\cdot CO_2H$. The *trans*-acid is acted on only with difficulty by bromine with formation of *trans*-*α*$_1$*β*-dibromo-*αα*-dimethylglutaric acid (m. p. 217°). It appears, therefore, that the *cis*- and *trans*-modifications of *αα*-dimethylglutaconic acid melt respectively at 134° and 172°. The bearing of this on the work of Conrad and of Henrich on this subject was discussed.

166. "A reaction of some phenolic colouring matters. II." By A. G. Perkin and C. R. Wilson.

By means of alcoholic potassium acetate, gallacetophenone gives the salts (*a*) $C_8H_7O_4K,H_2O$, and (*b*) $C_{24}H_{23}O_{12}K$. The former, pale yellow needles, identical with the compound which Nencki and Sieber (*Journ. pract. Chem.*, [ii], **23**, 23, 546) prepared with alcoholic potash, is anhydrous at 160°, and gives the salt $C_{16}H_{14}O_8Ba$, yellow needles. Sodium acetate gives the salt $C_8H_7O_4Na,H_2O$. With methyl iodide this gives *gallacetophenonemethyl ether*, $C_8H_7O_3(OCH_3)$, needles, m. p. 132—133°, the *diacetyl* derivative of which melts at 146—148°; and on methylation gallacetophenonedimethyl ether, m. p. 77—78°, (*Trans.*, 1895, **67**, 997) is formed. It is thus a para- or meta-methoxy-compound. The salt (*b*), colourless needles, is also formed from gallacetophenone and potassium acetate in aqueous solution and from this the compound $C_{48}H_{46}O_{24}Ba$ can be obtained.

The following salts have been prepared with alcoholic potassium acetate. Ellagic acid gives $C_{14}H_5O_8K$ and $C_{14}H_4O_8K_2$, daphnetin, $C_9H_6O_4,KC_2H_3O_2$, galangin, $C_{15}H_9O_5K,H_2O$, kampheride, $C_{16}H_{11}O_6K,H_2O$, dihydroxybenzalcumaranone ($OH:OH=6:7$), $C_{15}H_{10}O_4,KC_2H_3O_2$, carminic acid, $C_{11}H_{11}O_6K$ and $C_{22}H_{22}O_{12}Ba$, styrogallol, $C_{16}H_7O_5K$, naphthazarine, $(C_{10}H_6O_4)_2,KC_2H_3O_2$?, and curcumin, $C_{21}H_{19}O_6K$. By means of alcoholic potash, daphnetin gives the salts $C_{18}H_{11}O_8K$ and $C_9H_5O_4K$, and carminic acid the salt $C_{22}H_{23}O_{12}K$. From acetyl rhamnetin, the compound $C_{16}H_{11}O_7K$ was obtained.

Dimethoxyanhydroglycogallol, $C_{10}H_{10}O_4$, yellow needles, m. p. 122°, gives with protocatechuic aldehyde *dimethoxydihydroxybenzalcumaranone*, $C_{17}H_{14}O_6$, orange-coloured needles, which with potassium acetate gives the salt $C_{17}H_{13}O_6K$. *Pyrogallolmonomethyl ether*, incidentally prepared, melts at 102—104°, and not at 95° as given by Benedikt (*Ber.*, 1877, **9**, 125).

167. "Note on mixtures of constant boiling point." By S. Young, D.Sc., F.R.S.

It was noticed by Thorpe (*Trans.*, 1879, **35**, 544) that when a mixture of equal volumes of carbon tetrachloride and methyl alcohol is distilled a mixture of minimum boiling point, 55·6—55·9°, comes over first. The vapour density of this distillate was found to be 41·82, and the composition was therefore

Carbon tetrachloride	78·1
Methyl alcohol	21·9
	100·0

At Dr. Thorpe's suggestion, the author has determined the composition of the mixture of minimum boiling point by the distillation method, and also from the specific gravity of the mixture after redistillation.

The results are as follows :

Distillation Method.

	From excess of CH_3OH.	From excess of CCl_4.	From specific gravity.
CCl_4	79·99	79·35	79·44
CH_3OH	20·01	20·65	20·56
	100·00	100·00	100·00

The separation of the mixture of minimum boiling point from methyl alcohol is very much more difficult than from carbon tetrachloride, and it is in all probability for this reason that the percentage of alcohol in Thorpe's distillate was too high, whilst that calculated from the results of the distillation of a mixture containing excess of alcohol was too low. The most accurate value is probably that deduced from the specific gravity of the redistilled mixture of constant boiling point.

Determinations by Thayer (*Journ. Phys. Chem.*, 1898, 2, 382), Ryland (*Amer. Chem. Journ.*, 1899, 22, 384), and Carveth (*Journ. Phys. Chem.*, 1902, 6, 248) of the boiling points and composition of mixtures of benzene with ethyl and methyl alcohol were compared with those of Miss Fortey and the author (*Trans.*, 1902, 81, 739).

168. "The Vapour pressures and boiling points of mixed liquids. Part II." By S. Young, D.Sc., F.R.S., and Miss E. C. Fortey, B.Sc.

In a previous paper (*Trans.*, 1902, 81, 752) it was shown that, so far as mixtures of chlorobenzene and bromobenzene are concerned, the conclusion of van der Waals is true that if the critical pressures of the two liquids are equal and if the relation suggested by Galitzine and by Berthelot, $a_{1.2} = \sqrt{a_1a_2}$ holds good, the relation between vapour pressure and molecular composition should be represented by a straight line, or the vapour pressures of mixtures may be expressed by the formula $P = \frac{pP_A + (100-p)P_B}{100}$, where P, P_A, and P_B, are the vapour pressures of the mixture and of the two components A and B at the same temperature, and p is the molecular percentage of A.

It does not, however, follow that it is only when the critical pressures are equal that the vapour pressures agree with the formula; indeed Speyers goes so far as to state that it is always applicable to mixtures of liquids of normal molecular weight.

As the statement of Speyers is certainly too general, it seemed desirable to determine the boiling points of mixtures of a number of closely related compounds the critical pressures of which are not equal.

Four pairs of such liquids were examined, (1) ethyl acetate and ethyl propionate, (2) toluene and ethyl benzene, (3) *n*-hexane and *n*-octane, (4) benzene and toluene, and, in addition, carbon tetrachloride and benzene.

The investigation resulted in the following conclusions:—

1. The volume and temperature changes on mixing closely related substances are in all the observed cases very small, but it is only with chlorobenzene and bromobenzene that they can certainly be said to be within the limits of experimental error. With the two esters, these limits are very closely approached, whilst with benzene and toluene, which are somewhat less closely related, the changes are distinctly larger, and for mixtures of benzene with *n*-hexane and with carbon tetrachloride they are very much larger.

2. The formula $P=\frac{pP_A+(100-p)P_B}{100}$ is nearly, if not quite, true for closely related liquids, even when the critical pressures are widely different; it is not true, however, as a rule, for mixtures of liquids of normal molecular weight such as benzene and *n*-hexane, or for benzene and carbon tetrachloride, which are not closely related.

Of the five pairs of closely related liquids examined, it is only chlorobenzene and bromobenzene which show absolutely no temperature or volume change on mixing, and for mixtures of which the vapour pressures are accurately given by the above formula, and it is only this pair of liquids which have the same critical pressure. The deviations in the other cases are, however, so small that it remains an open question whether equality of critical pressure is a necessary criterion for absolute agreement with the formula. It appears, at any rate, that equality of critical pressure without closeness of chemical relationship is not a sufficient criterion.

It may be stated definitely that in the case of closely related substances, whatever their critical pressures, the deviations are, as a rule at any rate, exceedingly small.

Lastly, it is shown that there is strong evidence for the existence of mixtures of minimum boiling point in the case of carbon tetrachloride and benzene, and also of *n*-hexane and benzene, although the boiling points of the mixtures could hardly be distinguished from those of carbon tetrachloride and *n*-hexane respectively by ordinary thermometric methods.

169. "The vapour pressures and boiling points of mixed liquids. Part III." By S. Young, D.Sc., F.R.S.

If the vapour pressures of mixtures of two liquids, A and B, are accurately expressed by the formula $P = \frac{pP_A + (100 - p)P_B}{100}$ (where P, P_A, and P_B are the vapour pressures of the mixture and of the two components respectively at the same temperature, and p is the molecular percentage of A), and if the difference between P_A and P_B is small, the relation between the boiling points of the mixtures at constant pressure and their molecular composition is represented by a nearly straight line, and the temperature may with small error be calculated by means of the formula $t = t_B + \frac{p}{100}(t_A - t_B)$. The greater the difference between P_A and P_B, the greater is the deviation of the boiling point-composition curve from a straight line, and the higher is the molecular percentage of A in that mixture which shows the maximum deviation, D. This percentage is given with fair accuracy by the formula $p_D = 50 + 0{\cdot}18\Delta$ (where Δ is the difference between the boiling points of A and B), and the maximum deviation may be calculated with very slight error from the formula

$$D_2 = -\frac{0{\cdot}000158\Delta^2}{c'.T'} \cdot \frac{c_A}{c_B},$$

where c_A and c_B are the values of $\frac{dt}{dp} \cdot \frac{1}{T}$ for the two components $c' = \frac{(50 + 0{\cdot}18\Delta)c_A + (50 - 0{\cdot}18\Delta)c_B}{100}$ and

$$T' = \frac{(50 + 0{\cdot}18\Delta)T_A + (50 - 0{\cdot}18\Delta)T_B}{100}.$$

The values of D_2, calculated from the above formula, and of D_1, deduced from the actual vapour pressures (*Trans.*, 1902, 81, 752) for nineteen pairs of closely related compounds, were shown in a table. The greatest difference between D_2 and D_1 is 0·16°, although the actual value of D_1 is in one case $-32{\cdot}8°$. The boiling point curves have been determined experimentally in five cases, and the maximum deviation, D_3, read from the curves; the greatest difference between D_3 and D_1 is 0·27°.

For mixtures of liquids which are not closely related, the formula $P = \frac{pP_A + (100 - p)P_B}{100}$ is not, as a rule, applicable, but if the ratio $\frac{c_A}{c_B}$

lies between 0·95 and 1·05 (probably between 0·9 and 1·1), D_2 agrees well with D_1, and in other cases the difference rarely amounts to one degree. The observed boiling points of mixtures differ, however, as a rule, from those deduced from the vapour pressures, more especially when the molecules of one or both liquids are associated.

Whether a mixture of constant boiling point can be formed or not depends chiefly on the relative values of Δ and $D_3 - D_1$. If Δ is very small, such a mixture may be formed even when the difference between D_3 and D_1 is less than 1°, as in the case of carbon tetrachloride and benzene ($\Delta = 3{\cdot}44^\circ$, $D_3 - D_1 = -0{\cdot}89^\circ$). On the other hand, methyl alcohol and water do not form such a mixture, although $D_3 - D_1 = -4{\cdot}95^\circ$, Δ having in this case the high value $35{\cdot}11^\circ$.

170. "Note on the condensation points of the thorium and radium emanations." By E. Rutherford and F. Soddy.

It was shown (*Trans.*, 1902, 81, 342) that the radioactive emanation from thorium compounds passed in unchanged amount through a tube cooled to −78° with solid carbon dioxide and ether. The acquisition of a liquid air plant has enabled the authors to repeat the experiment at a lower temperature, with the result that they have now succeeded in condensing both the thorium and the radium emanations.

A current of hydrogen (or of air) was passed through the thorium or radium compound, and thence through a copper spiral cooled in liquid air. No trace of emanation escaped in the issuing gas either in the case of radium or of thorium. At the temperature of liquid air the emanations are therefore either condensed or lose their activity.

The radium (or thorium) compound was then removed, and the gas current sent directly through the spiral tube, which was quickly taken out of the liquid air and placed in cotton cool. Nothing happened for two or three minutes as the temperature of the spiral slowly rose, until suddenly the presence of the emanation was observed in large amount in the escaping gas. The result therefore cannot be explained by supposing that the emanations lose their ionising power at the temperature of liquid air. It is clear that they are condensed and again volatilised. From the sharpness and suddenness of the phenomena there appeared to exist for each emanation a definite temperature of volatilisation. This temperature is very nearly the same in the two cases and considerably above the boiling point of liquid air.

By measuring the temperature of the copper spiral at the instant of volatilisation, it was found that successive determinations agreed amongst themselves to within a degree. The exact temperatures cannot yet be given, but as a first approximation it may be said that for the radium emanation the volatilisation point lies in the neighbourhood of – 130° and for the thorium emanation about five degrees lower.

This experiment furnishes an additional proof—if such were needed—that radioactivity is accompanied by the continuous production of special kinds of active matter, which possess distinct and sharply defined chemical and physical properties.

171. "Note on the action of barium hydroxide on dimethylvioluric acid." By Miss M. A. Whiteley, D.Sc.

When dimethylvioluric acid is decomposed by boiling with barium hydroxide, the chief product is *iso*nitrosomalondimethylamide, which crystallises in well developed prisms belonging to the monosymmetric system ($a : b : c = 1{\cdot}53394 : 1 : 0{\cdot}88680$; $\beta = 68°43'$); it melts at 157°, and yields a yellow potassium salt and a purple ferrous salt, both of which are crystalline. In addition to this compound, six other decomposition products can be isolated, one, melting at 239—240°, has not been identified, the other five are carbon dioxide, oxalic acid (as barium salts), monomethyloxamide, methylamine, and methylamine oxamate. Andreasch (*Monatsh.*, 1895, **16**, 17), who first examined this reaction, obtained only three products, namely, carbon dioxide, methylamine, and a crystalline compound melting at 228° which he identified as *iso*nitrosomalondimethylamide; this investigation, however, indicates that it was probably an impure specimen of monomethyloxamide.

172. "The determination of strychnine and brucine in nux vomica." By E. Dowzard.

In order to determine the strychnine, the pure mixed alkaloids are dissolved in 50 c.c. of 2 per cent. sulphuric acid, 5 c.c. of nitric acid are added, and the mixture allowed to stand for 15 minutes, the solution is transferred to a separator containing 15 c.c. of ammonia (sp. gr. 0·890) and 10 c.c. of chloroform, the mixture is shaken for 5 minutes, the solvent separated, and the alkaline liquid again shaken with 10 c c. of chloroform. The mixed chloroform washings are now shaken with 15 c.c. of dilute ammonia (1 c.c. of above mentioned strength, diluted to 45 c.c.), this is repeated twice, the chloroform evaporated off, and the residue dried at 100° until constant.

To determine the brucine, a standard brucine solution is required, which is made by dissolving 0·16 gram of anhydrous brucine and 0·16 gram of strychnine in 2 per cent. sulphuric acid and the solution made up to 100 c.c. Then 0·10 gram of the pure mixed alkaloids is dissolved in 50 c.c. of 2 per cent sulphuric acid, this solution and 50 c.c. of the standard are placed in two small beakers, 5 c.c. of nitric acid (sp. gr. 1·42) are added simultaneously to the contents of each beaker; the solutions are then transferred to the comparison troughs of a Gallenkamp colorimeter. Five minutes after adding the nitric acid, six readings are taken; from the average of these, the brucine is calculated.

Results were given which proved the accuracy of the determination made by both these methods.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 8th.

At the next meeting, on **Thursday**, December 4th, at **8** p.m., when there will be a Ballot for the Election of Fellows, the following papers will be communicated :

"The absorption spectra of metallic nitrates. Part II." By W. N. Hartley, D.Sc., F.R.S.

"The specific heats of liquids." By H. Crompton.

"The constitution of enolic benzoylcamphor." By M. O. Forster.

"Isomeric benzoyl derivatives from *iso*nitrosocamphor." By M. O. Forster.

"The constitution of the products of the nitration of *m*-acetoluidide." By J. B. Cohen and H. D. Dakin.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on **December 4th**, 1902.

Alder, John Frederick,

13, Priestwood Mansions, Highgate, N.

Headmaster of the Higher School, East Finchley, N. Inter.B.Sc. (Lond.), Qualified Science Teacher under Science and Art Department; two years Demonstrator at High School, Middlesbrough, three years Science Master, East Finchley Science School; Lecturer in Chemistry to the Middlesex County Council (Finchley Centre).

J. Archyll Jones. John Geo. Taylor.
Frederick Doyle. *George Dean.*
A. Greeves.

Beanes, Alfred Edward,

Moatlands, Paddock Wood, Kent.

Analytical and General Chemist at Falcon Works, Wallis Road, Hackney Wick. Formerly Chemical Student at King's College, London, under Professor J. M. Thomson.

R. L. Barnes. T. A. Lawson.
W. S. Simpson. F. Evershed.
R. Meldola.

Blair, Herbert,

No. 3, General Hospital, Kroonstad, O.R. Colony, or c/o Robert Blair, Solicitor, Harton Lodge, Harton, South Shields, England.

Compounder of Medicines, Analytical Chemist and Assayer ; Student in Chemistry and Assaying at the Durham College of Science, Newcastle-upon-Tyne.

John C. Hewlett. P. Phillips Bedson.
Charles Mills. F. C. Garrett.
S. Hoare Collins.

Brincker, John Augustus Herman,

7, St. Mary's Terrace, Paddington, London, W.

Medical Officer to the Croydon Borough Fever Hospital, and Bacteriologist to the Croydon Borough. B.A. (Cantab ; First Class Natural Science Tripos), 1896 ; B.A. (Univ. Cape of Good Hope—Honours in Mathematics and Science), M.B., B.C. (Cantab) ; M.R.C.S. (Eng.), L.R.C.P. (Lond.) ; D.P.H. (Cantab), D.P.H., R.C.P.S. England, Late Assistant to the Prof. of Chemistry, U.C.G.H. ; Government Scholar in Chemistry, Univ. C.G.H. ; Porter Student and Univ. Scholar, U.C.G.H. ; Foundation Scholar St. John's College, Cantab. and Univ. Exhibitioner in Natural Science, St. Mary's Hospital.

James Moir. Edward A. Andrews.
Henry Kenwood. Arthur P. Luff.
Christopher Childs. *J. F. Braga.*
W. H. Corfield. *Samuel Rideal.*

Bryant, Vernon Seymour,

Camborne, Cornwall, England.

Chief Chemist to the Egyptian Salt and Soda Company, Natural Soda Works, Bir Hooker, Wadi Natron Estate, Lower Egypt. Senior Minor, and Foundation Scholar and Natural Science Prizeman of Downing College, Cambridge. B.A. Nat. Sci. Tripos, 1899.

W. J. Sell. John J. Beringer.
Ayerst Henham Hooker. Henry Jackson.
W. H. Lewis.

Carmichael, Thomas Burnell,

Parton, Whitehaven, at present living at 415, Walton Breck Road, Anfield, Liverpool.

Student with Messrs. A. Norman Tate & Co., Hackins Hey, Liverpool, Analytical Chemists. Previous to the above was a student in the

Laboratory of the Mossbay Hematite Iron and Steel Co.. Workington, Cumberland, with Mr. G. Valentine, Chief Chemist.

J. W. Clayton. T. Armistead Ward.
Wm. Hall Jowett. William Harrington.
Archd. Kitchin.

Cockle, Charles,

Peter Symonds' School, Winchester.

Science Master. Two years' training at the Royal College of Science, South Kensington; 1893—1895. 1st Class Honours, 1896, Practical Inorgan. Chem. Seven years' experience in teaching Chemistry in Secondary Schools: Dorchester Grammar School; Camberwell Grammar School; Peter Symonds' School, Winchester. My chief reason for being admitted is to secure the best literature on Chemistry.

M. O. Forster. H. Burrows.
G. T. Morgan. J. W. Hinchley.
W. Palmer Wynne.

Drought, James Justinian,

P.O. Box 4058, Johannesburg. Present address, Woodlands, Blackrock, Co. Dublin.

Assayer and Consulting Chemist. Member of the Chemical and Metl. Society of South Africa. Chief Assayer, the Lancaster Gold Mining Co., Krugersdorp. Cyanide Manager and Acting General Manager, the Nooitgedacht E. and G.M. Co., Lydenburg. Consulting Chemist to the Langlaagte Recovery Works, Ltd. Johannesburg.

W. N. Hartley. George T. Holloway.
J. Holms Pollok. *W. F. Cousins.*
W. E. Adeney.

Edlin, Edgar Leeder, B.A.,

Marsh Parade, Newcastle, Staffs.

Senior Science Master, the High School, Newcastle, Staffs. Formerly Science Exhibitioner at Merton College, Oxford, 1st Class in Honours Chemistry, Natural Science School, in June, 1900; now Senior Science Master, Newcastle, Staffs.

John Watts. J. E. Marsh.
W. W. Fisher. H. A. Miers.
V. H. Veley. H. L. Bowman.

Edwards, Walter Henry,

The Grammar School, Wellingborough, Northants.

School Master. Science Master, Wellingborough Grammar School since 1895.

H. Brereton Baker. R. H. Aders Plimmer.
Frank Clowes. R. T. Lattey.
Arthur H. Coote.

Green, George Felix Dudbridge,

Rosslea, 9 Ross Road, South Norwood, S.E.

Analytical Chemist. At present Assistant to Mr. Matthew J. Cannon, F.C.S. General and Scientific Education, Dulwich College, S.E., and Lycée Jansan, Paris. First year of Diploma Course at City and Guilds under Professor Henry Armstrong. Two years under Professor J. M. Thomson, King's College, W.C. Course of Bacteriology under Professor Cruickshank. Passed the Intermediate for A.I.C., July 1901. Now Assistant to Mr. M. J. Cannon, F.C.S.

John M. Thomson. D. Northall-Laurie.
Herbert Jackson. Matthew J. Cannon.
Patrick H. Kirkaldy. Robert Yates.
C. T. Kingzett.

Grimwade, Wilfred Russell,

Melbourne, Australia.

Manufacturing Chemist. Bachelor of Science of the Melbourne University.

Orme Masson. Robert N. Lennox.
Thomas Tyrer. *N. H. Martin.*
J. Lewkowitsch. *Walter F. Reid.*
J. Campbell Brown.

Gumersall, Edward,

Atbara, Sidcup, Kent.

Sub-Inspector Board of Education. Certificate for Associateship Course in Chemistry of Royal College of Science, London. Have been engaged in promoting the teaching of the subject under the Board of Education for the past eight years.

T. E. Thorpe. R. Meldola.
W. Palmer Wynne. A. E. Tutton.
Chapman Jones.

Hollingworth, David Vincent,

Aldred House, Crescent, Salford.

Analytical Chemist. Have had four years' training in Inorganic and Organic Chemistry, Coal Tar Products, &c., &c., at Royal Technical Institute, Salford. I have position as chief chemist at Stretford Gas Works, and desire to keep myself well informed in Modern Chemistry by perusal of the literature of the Chemical Society.

Jas. R. Appleyard. Ernest Clark.
J. R. Denison. *James Walker.*
John S. Lumsden.

Holt, Alfred, jun., B.A. (Camb.),

Crofton, Aigburth, Liverpool.

Research Student in the Owens College, Manchester. Studied Chemistry at Cambridge, and worked with Professor Moissan at the Sorbonne, and has published two papers in conjunction with M. Moissan on the preparation of two silicides of vanadium.

Harold B. Dixon. W. H. Perkin, jun.
Norman Smith. J. F. Thorpe.
D. L. Chapman. Francis V. Darbishire.

Hosking, Arthur Francis,

Roskear Villas, Camborne, Cornwall, England.

Chief Chemist of the Cyanide Works, and Reduction Plant of the Aruba Gold Concession, Limited, Aruba Island, D.W.I. 1891—1893 private student assistant to John J. Beringer, Esq., A.R.S.M., F.I.C., F.C.S., obtaining Honours in Chemistry and Metallurgy, South Kensington Exams. First position in Cornwall both years, and highest council prizes. 1893 to 1896 (three years), Demonstrator in Honours Chemistry, Metallurgy, and Assaying at the Camborne Mining Schools, Cornwall. During this period I made the complete analyses of rock formations for the Geological Surveys made by the President of the Cornwall Geological Society. I received the highest award of the Royal Cornwall Polytechnic Society for complete analyses with microscopic sections and diagrams of various strata from the bottom of the Dolcoath Tin Mine in Cornwall. Also, for a period of over a year I made the assays of white tin and arsenic productions of the Drakewall Tin, Copper, and Arsenic Mines in North Cornwall, to the thorough satisfaction of the mine and the arsenic refiners who were the buyers. July 1896 to end of 1898. Engaged as assistant manager and technical expert to the Cassinga Concession's Prospecting Expedition in Angola, South-west Africa. 1899 to April 1900. Special studies and research work on working potass cyanide liquors, &c., at the Camborne Mining School Laboratory. During this period I was awarded the silver medal of the Mining Association and Institute of Cornwall and Devon for chemistry, metallurgy, and allied subjects. April 1900 to date. Chief chemist of the Cyanide Works and reduction Plant of the Aruba Gold Concession, Aruba Island, Dutch West Indies.

Thomas Blackburn. J. J. Beringer.
H. R. Beringer. *H. W. Hutchin.*
John Gill.

Jackson, Clements Frederick Vivian,
Brisbane.

Assistant Government Geologist of Queensland. Bachelor of Mining and Metallurgy (Sydney University, 1900); Student for three years in the Chemical and Metallurgical Laboratories, University of Sydney, under Prof. Liversidge and Mr. J. A. Schofield. First Class honours Quantitative and Qualitative Analysis; First Class honours General Chemistry; Second Class honours Metallurgy and Assaying; First Class honours Physics; Slade Prize for Practical Physics; Bachelor of Civil Engineering (Sydney University, 1895); Associate Member of the Institution of Civil Engineers (London).

A. Liversidge. Chas. Watkin.
J. A. Schofield. J. Brownlie Henderson.
Basil Turner.

Jardine, Douglas Kennedy, B.Sc.,
20, Doune Terrace, Kelvinside, Glasgow, N.

Analytical Chemist. Studied at Owens College for five years, 1894–1898, and later at the Laboratory of the City Analysts, Messrs. R. R. Tatlock and Thomson, 1899 till date. Work consisted of analyses of every class, Scientific and Commercial. Holds Degree of Bachelor of Science.

R. R. Tatlock. W. H. Perkin, jun.
H. B. Dixon. G. H. Bailey.
D. L. Chapman.

Leather, John Petty,
17, Carlton Road, Burnley.

Gas Engineer and Manager of Burnley Corporation Gas Works. Studied Chemistry under Profs. Roscoe and Schorlemmer, 1876—1879. Since then Assistant Manager and Chemist, and for last twelve years Engineer and Manager of Burnley Corporation Gas Works. Joint author of paper (*Soc. Chem. Ind.*) on the Constitution of Gas Oils. At present engaged with Mr. Ross in a research on Borneo oil.

Raymond Ross.	George Embrey.
Wilfred Irwin.	Chas. J. Waterfall.

James Bertram Russell.

Lidbury, Frank Austin, M.Sc.,
Owens College, Manchester.

Demonstrator and Assistant Lecturer in Chemistry in the Owens College. Studied Chemistry at the Owens College (B.Sc., 1898), Research work with Prof. Ramsay and Prof. Ostwald. Has published, in the *Journal Chem. Soc.*, two papers, and one paper in *Zeit. Phys. Chem.*

Harold B. Dixon.	J. F. Thorpe.
W. H. Perkin, jun.	D. L. Chapman.
Norman Smith.	Francis V. Darbishire.

Liotard, Ernest,
2, Rue de France, Nice, France.

Pharmacien de première classe, Membre de la Société chimique de Paris, de la Société de pharmacie de Moscou, de Médecine de Nice. Auteur du traité d'analyse des urines, des hüiles essentielles des essences antiseptiques, du manuel de pharmacologie, et de notes de chimie.

Alfred H. Allen.	G. E. Scott-Smith.
Arnold R. Tankard.	*G. T. W. Newsholme.*

L. Troost.

Logan, Thomas Stratford,
52, Kirkgate, Leeds.

Physician. Studied Chemistry and allied subjects at Queen's College, Belfast, and at Yorkshire College, Leeds; Experience of Public Health Chemistry in the Sanitary Department of Leeds Corporation.

H. M. Dawson.	H. D. Dakin.
A. Turnbull.	J. K. S. Dixon.

B. A. Burrell.

MacCallum, Douglas A.,

10, Midlothian Drive, Shawlands, Glasgow.

Manufacturing, Analytical, and Consulting Chemist. Office address: Central Chambers, 93, Hope Street, Glasgow. (1) Technical College, Student and Assistant to Chemical Professor there, 3 years. (2) Iron and Steel Works Chemist, and latterly Assistant Manager; analytical work; research and investigations in connection with practical working, &c., 13 years. (3) Manufacturing and consulting privately, 2 years. (4) Member Society of Chemical Industry and West of Scotland Iron and Steel Institute.

A. Humboldt Sexton. James McCracken.
R. R. Tatlock. *John Clark.*
R. T. Thomson. *G. G. Henderson.*

Mann, William, B.Sc. (Lond.),

Fonnereau Villa, Dartford.

Science Lecturer; Lecturer in Organic Chemistry and Mathematics, Technical Schools, Southend-on-Sea. Two years Teacher of Physics, Boulevard Science School, Hull. Bachelor of Science (London). Am desirous of keeping in touch with all branches of Chemical Science.

Alf. J. Parker. Jas. Baynes.
F. W. De Velling, Thomas Luxton.
W. H. Templeman.

Marsh, John,

29 High St., Maidstone.

Assistant Chemist to the Associated Portland Cement Manufacturers, Ltd. I have taken the 3 years' Diploma Course in Chemistry at the Central Technical College, Exhibition Rd., S.W.

Henry E. Armstrong. T. M. Lowry.
Gerald T. Moody. William A. Davis.
Edward W. Lewis.

Mellor, Joseph William,

62 Bland Street, Moss Side, Manchester.

Doctor of Science, (N.Z. University); First Class Honours (chemistry); 3 years 1851 Exhibition Scholar; late Senior Scholar (N.Z. University); engaged in Research work, as Research Fellow, at the Owens College from 1899 up to present time; published papers in *Transactions Chemical Society* "On Union of H and Cl," &c.; and papers in other Scientific Journals. Author of "Higher Mathematics for Students of Chemistry," &c. (Longmans, Green and Co., London).

H. B. Dixon. W. H. Perkin, jun.
J. F. Thorpe. Francis V. Darbishire.
R. S. Hutton.

Millington, John Price,

Christ's College, Cambridge.

Student. Junior Demonstrator in the Camb. University Chemical Laboratory, Scholar of Christ's College, Cambridge. First Class in Natural Sciences Tripos Part I., B.A. (Camb.), B.Sc. (Wales).

G. D. Liveing.
W. J. Sell.
H. J. H. Fenton.
H. O. Jones.
T. B. Wood.

Phelps, John,

Trinity College, Oxford.

Student of Chemistry. B.A. (Oxon), Millard Scholar, Trinity College, Oxford. Honours in Chemistry, 1st Class, Natural Science Final Schools, Oxford 1902.

H. Brereton Baker.
D. H. Nagel.
Henry A. Miers.
Arthur J. Webb.
J. E. Marsh.
N. V. Sidgwick.

Ricketts, Guy Dunstan,

Sir John Cass Technical Institute, Jewry Street, E.C.

Lecturer on Metallurgy at the above Institute. M.A. (Cantab.), Natural Sciences Tripos, Part I., 1898; Associateship Examination in Metallurgy, Royal School of Mines, 1900; Assistant in Sir W. C. Roberts-Austen's Research Laboratory, 1901.

W. C. Roberts-Austen.
T. K. Rose.
Charles T. Heycock.
Charles A. Kohn.
W. H. Merrett.

Ross, George Archibald Park,

20, Westhall Gardens, Edinburgh.

Medical Practitioner (M.B., Ch.B. Edin.). Graduated M.B. Ch.B. at Edinburgh in 1901. D.P.H. of the Royal Colleges Edin. in 1902. Intend taking up Public Health work in the Colonies and am desirous of keeping in touch with Chemical progress.

G. H. Gemmell.
Hugh Marshall.
William C. Ross.
J. Falconer King.
Alex Crum Brown.
Thos. Darling.
Leonard Dobbin.

Sampson, John William,

Helpringham, Heckington, Lincs.

Analytical Chemist. For two years engaged in Organic and Analytical Chemistry under Mr. F. Bedford, B.Sc. (Lond.). For some time demonstrator in Practical Chemistry at Metropolitan College of Pharmacy. Have passed Major Exam. of Pharmaceutical Society. Desirous of increasing my knowledge of Chemistry.

F. Stanley Kipping. R. M. Caven.
G. Druce Lander. Fred Bedford.
W. Watson Will. Harry Lucas.
F. Filmer De Morgan.

Sindall, Robert Walter,

80, Manor Rd., Brockley, London, S.E.

Analyst, Chemical Engineer, Paper Trade Expert. Student under Professor Armstrong at the City and Guilds Institute, South Kensington. For some years Analyst and Chemical Engineer to Messrs. Edward Lloyd, Ltd. Papermakers, England, Norway, Canada. Now Consulting Chemist and Expert to the Pulp and Paper Trades.

Henry E. Armstrong. W. Palmer Wynne.
H. F. C. Goltz. William J. Pope.
Stanley J. Peachey. Clayton Beadle.

Simpson, Duncan,

10, Brynmill Crescent, Swansea.

Assayer. Having had 18 months' study of Analytical Chemistry under the late W. Terrill, Esq.; 3 months' practice in the Cape Copper Co.'s Laboratory; 3 years at the Swansea Hæmatite Iron and Steel Works under F. B. Last, Esq.; 13 months in Emu Spelter Works, research and analytical work under Messrs. Sulman and Picard on their patent process for treatment of sulphide ores of lead and zinc, and having in connection with this last invented and protected a process for the treatment of the furnace residues, and having since been engaged at J. S. Merry and Co.'s Lab. in work on Au, Ag, Cu, and Pb ores, &c., and having during the whole of the last seven years attended South Kensington night classes in Chemistry, Metallurgy, and Physics, Hons. Certificate.

E. Howard Tripp. Godfrey Millard.
Christopher James. Frank B. Last.
L. Ludlow. *John W. Bevan.*
Clarence A. Seyler.

Smith, Leonard,

14, West Hill, Highgate, London, N.

Student of City and Guilds of London Central Technical College. I have been a student in the Chemical Department of the above College for three years and am now engaged in research.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. T. Martin Lowry.
Edward W. Lewis.

Smythe, John Seabury, B.Sc., Ph.D.,

143, Smithdown Lane, Liverpool.

Analytical Chemist. B.Sc. (Vict.) Honours Chemistry 1897; Ph.D. (Würzburg) 1899. Chemist with Messrs. W. Meadowcroft and Son, Ltd., Blackburn, Essence Distillers and Manufacturing Chemists, since January, 1900.

J. Campbell Brown. Herbert B. Stocks.
W. Collingwood Williams. *Prosper H. Marsden.*
F. H. Tate.

Stansfield, Edgar, B.Sc.,

Technical College, Sunderland.

Assistant Lecturer and Demonstrator in Chemistry, the Technical College, Sunderland. Student at Owens College 1897—1901, elected a Research Student October 1901. Obtained degree of B.Sc. (Vict.) Honours School of Chemistry, June 1900. Original Research: "Preliminary Note on the Preparation of Barium" read before the Manchester Lit. and Phil. Society October 29, 1901.

H. B. Dixon. J. F. Thorpe.
W. H. Perkin, jun. R. S. Hutton.
E. Clark.

Sutherst, Walter Frederick,

Cheshire Agricultural College, Holmes Chapel.

Lecturer in Chemistry and Analyst. Diploma of Federal Polytechnic, Zürich. Ph.D. (Geneva). A.I.C. Published following investigations: "The Solubility of Phosphatic Manures in some Organic Acids" (*Chem. News*, 2187); "the Freezing Point of Vegetable Saps and Juices" (*Chem. News*, 2190); "Influence of Manuring on Chemical Composition of Potatoes" (*Chem. News*, 2192); "Effect of Lime on the Insoluble Phosphates in Soils" (*Chem. News*, 2210); "the Composition of Colostrum" (*Chem. News*, 2223); "the Reversion of Superphosphate in Soils" (*Agricultural Gazette*, Sept. 1st, 1902); "Chemical Changes in the Ripening of Cheshire Cheese" (*Soc. Chem. Ind.*, Feb. 28th, 1902). Thesis: "Derivatives of Naphthazonium."

Edric Druce. Bernard Dyer.
J. Carter Bell. Walter M. Gardner
A. B. Knaggs.

Thomson, George Sutherland,

Government Offices, Adelaide, South Australia.

Scientific Dairy Expert to the Government of South Australia. Author of "Preservatives in Dairy Produce, with Analyses"; "Causes of Variation in the Water Percentage of Butter (with analyses)"; "Cheese Experiments and Analyses"; "Cattle-feeding Experiments and Analyses," and "Stale Butter and Analyses," issued by the Government of South Australia. Instructor in Dairy Science at Government School of Mines; College of Agriculture; School of Agriculture; Agricultural Bureaus, and to the Dairy Factory Managers in South Australia.

Thomas S. Goodwin.
James Hendrick.
J. F. Blackshaw.
Frederick J. Lloyd.
C. M. Aikman.
James McCutcheon.
Jas. McCreath.

Tidy, Henry Letheby,
New College, Oxford.

Medical Student. Graduate in Chemistry of Oxford University.

William Odling.
James Dewar.
William Crookes.
Harold Hartley.
D. H. Nagel.

Wallis, Thomas Edward,
78, Essex Road, Islington, N.

Assistant Lecturer in Chemistry in the School of Pharmacy of the Pharmaceutical Society. B.Sc. (Lond.). Have published several papers dealing with the anatomy of drugs; 1899 to 1900 Junior Demonstrator in Practical Chemistry; 1900 to 1901 Demonstrator in Pharmaceutics in the School of Pharmacy.

J. Norman Collie.
M. Carteighe.
A. Lapworth.
Walter Hills.
D. Northall-Laurie.

White, William Carter,
113, Gower Street, W.C.

Analyst to Messrs. Geo. Curling, Wyman & Co., 58, Bunhill Row, E.C. Joint author of "Removal of Fat from Nux Vomica Preparations," *C. & D.*, lxi., p. 87. Author of "Cobalt Nitrate as a Reagent." *Ph. J.*, 4th series, 1674, p. 68.

William Fowler.
Peter MacEwan.
W. L. Howie.
Thomas Tyrer.
A. K. Huntington.

Wilson, Lyndon,
66, Castle Gate, Newark-on-Trent.

Analytical Chemist to Messrs. J. Richardson & Son, Newark-on-

Trent. Analytical Chemistry under J. Heron, Esq. Practical and Scientific Brewer and Maltster.

John Heron.	Arthur R. Ling.
Leonard Temple Thorne.	*E. Haynes Jeffers.*
Wm. G. Johnstone.	*F. Jewson.*

The following Certificates were authorised by Council under Bye-law I. (3):

Edminson, Sidney Robert,
Maritzburg College, Natal.

Schoolmaster. B.Sc. (London) in Chemistry, &c., for some years a chemical student at Firth College, Sheffield. Teacher of Chemistry at Maritzburg College, Natal, S. Africa. For five years Science Master at Wesley College, Sheffield.

Percy John Vinter.

Mukergee, Beni Madhav,
Roorkee, India.

Science Demonstrator, Thomason College, Roorkee, India. Graduate (science course) of the Allahabad University, formerly Science Demonstrator for four years in the Muir Central College, Allahabad. Since 1899, Demonstrator in the Thomason College, Roorkee, in which capacity he has to lecture to the Engineer Classes on Chemistry and also do the commercial analysis undertaken by the College.

Abhayacharan Sanyal.

Přibram, Richard, Ph.D.
The University, Czernowitz, Austria.

Professor of Chemistry in the University of Czernowitz.

Hans Meyer.	*William Ramsay.*

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 9/12/02

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

Vol. 18. No. 257.

Thursday, December 4th, 1902. Dr. W. H. Perkin, F.R.S., Vice-President, in the Chair.

Mr. J. H. Ryffel was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Cousins, Francis George, Queen's Road, London, N.
Elford, Archibald Sefton, B.A., 9, Keble Road, Oxford.
Huyin, Moung Tha, B.A., 18, Mercers Road, London, N.
Kemp-Welch, Maurice, Parkstone, Weybridge, Surrey.
Sibley, Samuel Edward, 3, Rutland Road, Ilford.
Turner, Duncan, Elmbank, Broomhouse, near Glasgow.

A ballot for the election of Fellows was held, when the following were declared duly elected :—

John Frederick Alder.
Alfred Edward Beanes.
Herbert Blair.
John A. H. Brincker, B.A., M.B.
Vernon Seymour Bryant, B.A.
Thomas Burnell Carmichael.
Charles Cockle.
James Justinian Drought.
Edgar Leeder Edlin, B.A.
Sidney Robert Edminson, B.Sc.
Walter Henry Edwards.
George Felix Dudbridge Green.
Wilfrid Russell Grimwade, B.Sc.,
Edward Gumersall.
David Vincent Hollingworth.
Alfred Holt, jun., B.A:
Arthur Francis Hosking.
Clements F. V. Jackson.
Douglas Kennedy Jardine, B.Sc.
John Petty Leather.
Frank Austin Lidbury, M.Sc.
Ernest Liotard.
Thomas Stratford Logan.
Douglas A. MacCallum.
William Mann, B.Sc.
John Marsh.
Joseph William Mellor, D.Sc.
John Price Millington, B.A., B.Sc.
Beni Madhav Mukerjee.
John Phelps, B.A.
Richard Přibram, Ph.D.
Guy Dunstan Ricketts, M.A.
George Archibald Park Ross, M.B.
John William Sampson.
Duncan Simpson.
Robert Walter Sindall.
Leonard Smith.
John Seabury Smythe, B.Sc., Ph.D.
Edgar Stansfield, B.Sc.
Walter F. Sutherst, Ph.D.
George Sutherland Thomson.
Henry Letheby Tidy, B.A.
Thomas Edward Wallis, B.Sc.
William Carter White.
Lyndon Wilson.

Of the following papers, those marked * were read :

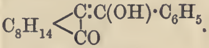
*173. "The specific heats of liquids." By H. Crompton.

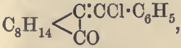
It is assumed that when heat is applied to a liquid, if there is no change in its molecular composition, (1) there is an increase in the kinetic energy of the molecules, (2) internal work is done within each molecule, (3) there is a diminution in the attraction of the molecules for one another, (4) some external work is done. The last quantity is neglected in considering the specific heat, and the first and second changes are taken to have the same effect on the specific heat of the liquid and on that of its vapour, so that together they make up the specific heat at constant volume of the vapour. At any absolute temperature T, the molecular heat at constant volume of the vapour $C_v = 2{\cdot}96 + 0{\cdot}000245 Mv_b T \log n$, where n is the number of atoms in the molecule, and Mv_b is the molecular volume of the liquid at the boiling point. The molecular attraction is regarded as measured by the difference between the latent heat of condensation of the vapour and the heat evolved on simply compressing the vapour into the volume of the liquid without causing a change of state. This attraction is assumed to become zero at the critical temperature and to increase regularly with the fall in temperature from the critical point downwards. At the absolute temperature T, the change in the attraction is therefore

$$dA/dT=(L-RT\log V_0/v_0)/(T_k-T),$$

in which L is the latent heat of condensation, R the constant of the gas equation, V_0 and v_0 the volumes of the vapour and liquid respectively, and T_k the absolute critical temperature. It follows from the above that the molecular heat of the liquid is $C_f=C_v+dA/dT$, and the author showed that the molecular heats of liquids thus calculated agree fairly with those observed, except where molecular association occurs in the liquid.

*174. "The constitution of enolic benzoylcamphor." By M. O. Forster.

From the production of camphorquinone by oxidising benzoylcamphor with chromic acid and with mercuric acetate, it is concluded that the enolic modification of benzoylcamphor has the constitution of *phenylhydroxymethylenecamphor*,  $\mathrm{C_8H_{14}}\left<\begin{array}{l}\mathrm{C{:}C(OH)\cdot C_6H_5}\\ \mathrm{CO}\end{array}\right.$.

Phenylchloromethylenecamphor,  $\mathrm{C_8H_{14}}\left<\begin{array}{l}\mathrm{C{:}CCl\cdot C_6H_5}\\ \mathrm{CO}\end{array}\right.$, obtained from enolic benzoylcamphor and phosphorus pentachloride, melts at 100° and its rotation $[\alpha]_D=-217°$; the alcoholic solution gives no coloration with ferric chloride. Aniline converts it into *anilinophenylmethylenecamphor anil*, $C_{29}H_{30}N_2$, sulphur-yellow plates m. p. 117—118°; the *acetyl* derivative, $C_{31}H_{32}ON_2$, melts at 166°.

When phenylchloromethylenecamphor is heated with alcoholic ammonia in sealed tubes at 150—170°, a *base* having the formula $C_{17}H_{21}ON$ is produced. This melts at 170°, its rotation $[\alpha]_D=+180{\cdot}2°$; it gives an intense blue coloration with ethereal ferric chloride; the *picrate* melts at 157° and the *benzoyl* derivative at 99—100°.

On heating enolic benzoylcamphor with ammonium formate in sealed tubes at 200—220°, another *base*, also having the formula $C_{17}H_{21}ON$, is formed. It melts at 118—119°, its rotation $[\alpha]_D=+235{\cdot}2°$: it gives no colour with ferric chloride; it does not combine with benzaldehyde or benzoyl chloride, but yields a *picrate* which does not melt at 250°, and a *bromo*-derivative, $C_{17}H_{20}ONBr_5$, orange-red plates, m. p. 173°.

Enolic benzoylcamphor is reduced in alkaline solution by sodium amalgam, yielding benzylidenecamphor and benzylcamphor. Potassium permanganate oxidises it to a mixture of benzoic and camphoric acids, whilst potassium ferricyanide gives rise to a *compound* having the formula $C_{34}H_{38}O_4$ and m. p. 221°, its rotation $[\alpha]_D = +270{\cdot}4°$; it does not react with ferric chloride, and is insoluble in alkalis.

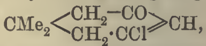
*175. "Isomeric benzoyl derivatives from *iso*nitrosocamphor."
By M. O. Forster.

When *iso*nitrosocamphor is treated with benzoyl chloride in presence of sodium hydroxide, two compounds are produced each having the empirical formula $C_{17}H_{19}O_3N$.

The *compound* from which *iso*nitrosocamphor can be regenerated by hydrolysis, crystallises from alcohol in large, yellow prisms melting at 105—106°; it is readily soluble in petroleum, and its rotation $[\alpha]_D = +145{\cdot}6°$ in chloroform. The *iso*nitrosocamphor obtained from this derivative has the rotation $[\alpha]_D = +221{\cdot}9°$, and yields the two new substances on benzoylation.

The compound which accompanies the above-mentioned derivative, although isomeric with it, does not give rise to *iso*nitrosocamphor on hydrolysis; it is scarcely soluble in petroleum, and crystallises from alcohol in colourless, lustrous laminæ melting at 136° and its rotation $[\alpha]_D = +126{\cdot}9°$ in chloroform. Alcoholic potash resolves it into a mixture of benzoic and cyanolauronic (α-camphornitrilic) acids.

*176. "Action of phosphorus haloids on dihydroresorcins. Part I. Dimethyldihydroresorcin." By A. W. Crossley and H. R. Le Sueur.

Phosphorus trichloride reacts with dimethyldihydroresorcin, giving 5-*chloro*-3-*keto*-1 : 1-*dimethyl*-Δ^4-*tetrahydrobenzene*,  $CMe_2{<}\begin{matrix}CH_2-CO\\CH_2\cdot CCl\end{matrix}{\gg}CH$, a colourless liquid boiling at 109° (14 mm.), and also small quantities of an *anhydride* of *dimethyldihydroresorcin*, $(C_8H_{11}O)_2O$, melting at 99·5°.

Phosphorus oxychloride gives the same chloroketone, and phosphorus tribromide the corresponding bromo-compound, $C_8H_{11}OBr$, which boils at 129° (25 mm.).

When phosphorus pentachloride acts on dimethyldihydroresorcin, 3 : 5-dichloro-1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene (*Trans.*, 1902, 81, 826) and 3 : 5-dichloro-*o*-xylene (*Trans.*, 1902, 81, 1533) are obtained.

By the action of phosphorus pentabromide on dimethyldihydroresorcin, bromodimethyldihydroresorcin is first formed, and the products of the action of the phosphorus bromides on this compound have been investigated. With phosphorus tribromide there is obtained a mixture of mono- and *di-bromoketodimethyltetrahydrobenzene*, the latter, having the formula $C_8H_{10}OBr_2$, melts at 96°; and a liquid which on treatment with bromine is converted into a *tribromoxylenol* which melts at 176—177·5°. By the further action of bromine the above dibromoketone is converted into *tri-* and *tetra-bromoketodimethyltetrahydrobenzene,* which melt respectively at 106° and 118°. These latter substances are also produced by the action of phosphorus pentabromide on bromodimethyldihydroresorcin.

The action of phosphorus pentabromide on dimethyldihydroresorcin is one which is largely influenced by the conditions under which the experiments are carried out. The following products of the reaction have been isolated: bromodimethyldihydroresorcin, tribromoketotetrahydrobenzene, a *bromoxylenol,* C_8H_9OBr, melting at 83·5—84°, a *dibromoxylenol* melting at 96·5°, and two *tribromoxylenols* melting at 176—177·5° and 182—183° respectively.

177. "The absorption spectra of metallic nitrates. Part II."
By W. N. Hartley, D.Sc., F.R.S.

The substances examined were aqueous solutions of the nitrates of fifteen metals, and of nitric, sulphuric, and hydrochloric acids, and alcoholic solutions of ethyl and lithium nitrates.

Metals which exhibit characteristic absorption bands show variations in the positions and intensities of these bands which appear to be dependent upon the molecular weights of the salts in solution. Equivalent quantities of certain metals exhibit the same absorption spectra whether in strong or dilute solution, and, in certain cases, through a great range in dilution. A dilute solution of silver nitrate transmits a longer range of spectrum than a strong solution containing the same quantity of salt. The effect of dilution on nitric acid of sp. gr. 1·42 is the reverse of that observed in the case of silver nitrate. There is a remarkable difference between the constitution of ethyl nitrate on the one hand (whether undiluted or in dilute alcoholic solution), and that of solutions equally dilute of inorganic nitrates on the other. The effect of raising the temperature of the solutions is simply to intensify the absorption spectrum as if a stronger solution at a lower temperature had been used.

Although evidence of what may be regarded as ionic dissociation is afforded by the spectra of dilute solutions of the inorganic nitrates, yet the spectra themselves are not alike, as they would be if the salts were completely resolved into NO_3 and metallic ions; the evidence is just as favourable to the view that some of the salts are resolved into nitric acid and the corresponding base.

In the case of esters, like ethyl nitrate, the conditions are entirely different, as the molecule is clearly not dissociated, there being no evidence of the $-NO_3$ group in the compound.

Views in explanation of the facts observed were put forward.

178. "The constitution of the products of nitration of meta-acetoluidide." By J. B. Cohen and H. D. Dakin.

The authors show that the nitro-derivative of *m*-acetoluidide obtained by Beilstein and Kuhlberg (*Annalen*, 1871, **158**, 348) contains the nitro-group in the para-position with respect to the amido-group, and not in the ortho-position as stated by Limpricht (*Ber.*, 1885, **18**, 403). The substance was successively converted into 3-chloro-6-nitrotoluene and 3-chloro-4 : 6-dinitrotoluene.

By fractional crystallisation from alcohol of the products of nitration, a nitro-derivative which had hitherto escaped observation was separated, which proved to be 4-nitro-3-acetylaminotoluene. On hydrolysis it gave a base identical with the 4-nitro-3-aminotoluene obtained by Staedel and Kolb (*Annalen*, 1890, **259**, 224) by the action of ammonia on 4-nitro-*m*-cresol ethyl ether.

179. "The action of metallic thiocyanates upon carbonyl chloride." By A. E. Dixon.

When carbonyl chloride dissolved in toluene is allowed to stand in contact with excess of finely divided sodium, potassium, barium, mercury, or lead thiocyanate, interaction gradually occurs with formation of metallic chloride, and a substance possessing the general chemical characters of a thiocarbimide, but giving, under certain conditions, the reactions of a thiocyanate. It has recently been pointed out by the author that tautomerism of this kind often occurs among the so-called "thiocyanates" of electro-negative radicles (*Trans.*, 1901, **79**, 541). The interaction may be represented thus: $COCl_2 + Pb(SCN)_2 = PbCl_2 + CO(NCS)_2$, but it does not take place quantitatively, *iso*persulphocyanic acid and *pseudo*-sulphocyanogen and occasionally other products being formed. Heating to about 100° greatly accelerates the change, but even after thirty hours not more than one-third of the carbonyl chloride employed is converted into thiocarbimide, and much remains unchanged.

Hitherto, all attempts to isolate carbonyldithiocarbimide in a pure state have failed, but its solution interacts with alcohol and with nitrogenous bases, yielding additive products.

Only one molecule of ethyl alcohol could be caused to unite with one of dithiocarbimide; the resultant *hemi*-thiourethane,

$$SCN{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}OEt,$$

was obtained in pale yellow prisms melting at 141—142°. It is insoluble in cold water, but decomposes when heated with water to near the boiling point, carbon dioxide and thiocyanic acid being formed.

By combination with aniline, compounds having either the formula $SCN \cdot CO \cdot NH \cdot CS \cdot NHPh$ or $CO(NH \cdot CS \cdot NHPh)_2$, can be obtained, according to the conditions. The former, *carbonylthiocarbimidophenylthiocarbamide,* crystallises from alcohol in brilliant, pearly leaflets which melt at 172°, then quickly resolidify, and now melt at 223°. It is insoluble in cold water, but gradually dissolves on boiling, becoming hydrolysed, carbon dioxide being evolved, whilst thiocyanic acid and phenylthiourea remain dissolved: $SCN \cdot CO \cdot NH \cdot CS \cdot NHPh + H_2O = CO_2 + HSCN + CSN_2H_3Ph$.

Carbonyldiphenyldithiocarbamide, $CO(NH \cdot CS \cdot NHPh)_2$, separates from alcohol in vitreous prisms which melt at 166° and are insoluble in boiling water. Both phenylated derivatives, as well as the *hemi*-thiourethane, are readily desulphurised by silver salts and by an alkaline lead solution.

Attempts to produce *hemi-* or complete thiourethanes by adding carbonyl chloride to potassium or barium thiocyanate in alcoholic solution were unsuccessful; the chloride first interacted with the alcohol, yielding ethyl chlorocarbonate, which, with the metallic thiocyanate, gave carboxyethylthiocarbimide, and this latter, combining with another portion of the alcohol, formed finally Doran's carboxyethylthiourethane (*Trans.*, 1896, 69, 334) or diethyl iminothiodicarbonate, $EtO \cdot CO \cdot NH \cdot CS \cdot OEt$.

The following compounds were also described:

Carbonylthiocarbimidoparatolylthiocarbamide,

$SCN \cdot CO \cdot NH \cdot CS \cdot NH \cdot C_7H_7$.

—Pearly leaflets melting at 182°, resolidifying at once, and now melting at 237°. In general properties, this and the naphthyl compound mentioned below closely resemble the phenyl homologue. *Carbonyldi-*o-*tolyldithiocarbamide,* $CO(NH \cdot CS \cdot NH \cdot C_7H_7)_2$.—M. p. 172° has properties similar to those of the corresponding diphenyl compound. *Carbonylthiocarbimido-α-naphthylthiocarbamide,*

$SCN \cdot CO \cdot NH \cdot CS \cdot NH \cdot C_{10}H_7$,

is a yellowish powder, m. p. 182°, resolidifying at once and then melting at 222°.

Carbonylthiocarbimidophenylbenzylthiocarbamide,

$SCN \cdot CO \cdot NH \cdot CS \cdot NPhBz$.

—Prepared from benzylaniline, it formed long, vitreous prisms having a faint yellow tinge, and melting with effervescence at 180°. When boiled with water it slowly undergoes hydrolysis, carbonic anhydride being evolved, thiocyanic acid passing into solution, and *αα*-phenylbenzylthiourea, $NH_2 \cdot CS \cdot NPhBz$, being left.

LIBRARY CATALOGUE.

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At the next ordinary meeting, on **Wednesday**, December 17th, at **5.30** p.m., the following papers will be communicated.

"A reagent for the detection of carbamide and of certain other nitrogen compounds." By H. J. H. Fenton.

"The rate of decomposition of diazo-compounds. Part. II. Diazo-compounds of the naphthalene series." By J. C. Cain and F. Nicoll.

"The state of carbon dioxide in aqueous solution." By J. Walker.

"The qualitative separation of arsenic, antimony and tin." By J. Walker.

"The hydrates and the solubility of barium acetate." By J. Walker and W. A. Fyffe.

"*cis-* and *trans-aβ*-Dimethylglutaric acid and the separation of the *cis-* and *trans*-forms of substituted glutaric acids." By J. F. Thorpe and W. J. Young.

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PROCEEDINGS

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CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

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Wednesday, December 17th, 1902. Professor J. Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Edwin Bayles Atkinson, Scarthe House, Great Grimsby.
William Bowen, Cleveden, Woodend Road, Erdington.
R. C. Farmer, M.Sc., Ph.D., 154, Eglinton Road, Woolwich, S.E.
Frederic Herbert Lees, 256, Park Road, Crouch End, N.
A. H. Scholefield, B.A., B.Sc., 4, Hartley Terrace, Wolverhampton.
Charles Tilburn, 31, Hardy Street, South Yarra, Melbourne.
Andrew Young, M.A., B.Sc., 1, Avenue Terrace, Cape Town.

The following Certificates were authorised by the Council under Bye-law I. (3):

K. Bhaduri, M.A., Professor, Canning College, Lucknow.
George Montague Prichard, Ramtek, Nagpur, C.P., India.

Of the following papers, those marked * were read:

*180. "A reagent for the identification of carbamide and of certain other nitrogen compounds." By H. J. H. Fenton.

In previous communications to the Society (Fenton and Gostling, *Trans.*, 1899, 77, 423; 1901, 81, 807), various derivatives of methylfurfural have been described which are obtained from ketohexoses, or substances which produce these on hydrolysis, and from cellulose. Amongst these derivatives, a crystalline condensation product was mentioned having the formula $C_{11}H_8O_4$, the constitution of which is still under investigation; the evidence obtained so far indicates that it is either methyl-furil, $C_4H_3O{\cdot}CO{\cdot}CO{\cdot}C_4H_2O{\cdot}CH_3$, or the ketone-aldehyde, $CHO{\cdot}C_4H_2O{\cdot}CO{\cdot}C_4H_2O{\cdot}CH_3$. The method of obtaining this substance has been considerably improved, so that it is now easy to prepare it in quantity. If a small quantity of this product be mixed with urea and the mixture treated with a trace of phosphorus oxychloride, acetyl chloride or dry hydrogen chloride—dissolved in any appropriate solvent—a very brilliant blue colour is obtained. The reaction is one of extreme delicacy, 0·1 milligram of urea giving a strongly marked colour, and with care it is quite easy to detect 0·01 milligram or less.

This effect is due to a colourless base of which the salts have a blue colour. The intensity of the colour of these salts in aqueous solution varies markedly with the nature and concentration of the acid.

The production of a blue colour in the manner here described is characteristic of carbamide and of mono-substituted carbamides, $NH_2{\cdot}CO{\cdot}NHR$, in which the substituting radicle is an alkyl group or one of a similar character; acidyl substituted carbamides give no such reaction. Urethane gives a similar reaction, but the colour is red by transmitted light.

This compound also reacts with primary amines in acetic acid solution to give very brilliant green compounds; this change is produced at once on simply mixing the solutions without any condensing agent, and appears to be quite characteristic of primary amines.

DISCUSSION.

Mr. C. E. GROVES asked whether oxalic acid behaved like sulphuric and hydrochloric acids.

Mr. FENTON replied that the base gave a blue colour with oxalic acid also, the intensity of the colour being greater than that produced with acetic acid, but less than that with hydrochloric acid.

*181. "The rate of decomposition of diazo-compounds. Part II. Diazo-compounds of the naphthalene series." By J. C. Cain and F. Nicoll.

The authors have extended their researches on the decomposition of diazo-salts (*Trans.*, 1902, 81, 1412) to those of the naphthalene series, and find that the reaction is a unimolecular one in the case of the soluble diazo-salts prepared from the following amines:

1. α-Naphthylamine.
2. β-Naphthylamine.
3. Naphthylaminesulphonic acid, $NH_2 : SO_3H = 1 : 8$.
4. ,, ,, ,, $= 2 : 6$.
5. ,, ,, ,, $= 2 : 7$.
6. ,, disulphonic acid, $NH_2 : SO_3H : SO_3H = 2 : 6 : 8$.
7. ,, ,, ,, $= 2 : 3 : 6$.
8. Amidonaphtholdisulphonic acid, $NH_2 : OH : SO_3H : SO_3H = 1 : 8 : 3 : 6$.

The unimolecular reaction, however, in the case of Nos. 1, 2, 4, 5, 7, 8, is hindered, after a considerable amount of decomposition has taken place, by the formation of azo-colours, which is clearly shown by the rapid diminution of the values of C, calculated according to the equation $\frac{1}{t}\log\frac{A}{A-x} = C$ (a constant).

The measurements were made at 60°, except in the case of No. 8, when the temperature was 80°. The diazo-salts are thus very stable.

In the case of the insoluble diazo-salts obtained from the following amines:

9. Naphthylaminesulphonic acid, $NH_2 : SO_3H = 1 : 2$.
10. ,, ,, ,, $= 1 : 4$.
11. ,, ,, ,, $= 1 : 5$.
12. Amidonaphtholsulphonic acid, $NH_2 : OH : SO_3H = 2 : 8 : 6$.

the rate of decomposition is expressed by the equation $\frac{x}{t} = K$ (a constant), x being the observed volume of nitrogen evolved in the time t.

In each case, an azo-colour is formed towards the end of the reaction, shown again by the rapid diminution of the values of K.

These diazo-salts are very stable, the experiments being made at 70° or 80°.

In each case where an azo-colour is formed, the value of C or K is constant for a considerable period, showing that, although both naphtholsulphonic acid and diazo-salt are present, no combination takes place during this period.

The authors suggest that this interesting fact may be explained by assuming that hydrolytic dissociation of the diazo-salt is necessary before combination takes place; in the above experiments, the diazo-salt is not dissociated (especially in the presence of the free mineral acid, which has a retarding effect on the formation of an azo-colour) until its concentration becomes considerably less. When this point is reached, the formation of an azo-colour can proceed.

*182. "State of carbon dioxide in aqueous solution." By J. Walker.

The author gave a proof from the law of mass-action that carbonic acid (and similar substances) in aqueous solution must obey Ostwald's dilution law, independently of the proportions of the anhydrous and hydrated forms contained in the solution. The conclusion formerly drawn (Walker and Cormack, *Trans.*, 1900, 77, 8), that the carbon dioxide in solution is probably hydrated to the extent of 20 per cent., must therefore be rejected.

*183. "Qualitative separation of arsenic, antimony, and tin." By J. Walker.

When a solution of the sodium thio-salts of arsenic, antimony, and tin is boiled with sodium peroxide, these salts are converted into sodium arsenate, antimonate, and stannate respectively. Any mercury which may have been dissolved from the copper group on warming with sodium hydroxide, is, by this treatment, reprecipitated as sulphide. The tin may be separated from the arsenic and antimony by boiling with excess of ammonium chloride, which precipitates stannic hydroxide, leaving the antimony and arsenic in solution. On addition of excess of acid, these may be separated by means of sulphuretted hydrogen in the cold, the antimony being at once precipitated as sulphide, whilst the arsenic remains dissolved.

DISCUSSION.

Dr. F. M. PERKIN remarked that when stannous sulphide does not dissolve in caustic alkali, the addition of a little sodium or hydrogen peroxide enables it to do so. The peroxide seems to exert very little, if any, oxidising action upon the sulphides of the copper group, hence there is no objection to warming the mixed sulphides of these two groups with caustic alkali and sodium peroxide and so obviating the use of ammonium sulphide.

*184. "The hydrates and solubility of barium acetate." By J. Walker and W. A. Fyffe.

The authors have been unable to confirm the observations of Krasnicki (*Monatshefte,* 1887, 8, 601), who stated that the solubility of barium acetate between 0° and 80° could be represented by a single curve concave to the temperature axis. On the contrary, they find that the solubility is expressed by three curves (for the trihydrate, monohydrate, and anhydrous salt, respectively), which are all convex to the temperature axis. The curve for the monohydrate exhibits a minimum at 30°, and that for the anhydrous salt a minimum at 75°.

The solubility and special dilatometric experiments showed the inversion temperature for $Ba(C_2H_3O_2)_2,3H_2O \rightleftarrows Ba(C_2H_3O_2)_2,H_2O + 2H_2O$ to be 24·7°; that for $Ba(C_2H_3O_2)_2,H_2O \rightleftarrows Ba(C_2H_3O_2)_2 + H_2O$ being 41°.

DISCUSSION.

Professor **Tilden** expressed the belief that revision of many of the accepted data in regard to solubility was urgently required and hoped that Professor Walker would continue his work in this direction. Published estimations of solubility of many metallic salts at temperatures above the boiling point of water were absolutely valueless, inasmuch as evident chemical change sets in and basic salts are visibly deposited.

*185. "*cis-* and *trans-αβ*-Dimethylglutaric acid and the separation of the *cis-* and *trans*-forms of substituted glutaric acids." By J. F. Thorpe and W. J. Young.

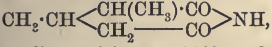
The *αβ*-dimethylglutaric acids are best prepared by the condensation of ethyl *β*-methylacrylate with ethyl sodiocyanacetate and subsequent treatment of the sodium derivative formed with methyl iodide.

Ethyl α-cyano-αβ-dimethylglutarate,

$$CO_2Et\cdot C(CN)(CH_3)\cdot CH(CH_3)\cdot CH_2\cdot CO_2Et,$$

is a colourless oil which boils at 185° (20 mm.), which, with cold methyl alcoholic potash, yields the *potassium* salt. *α-cyano-αβ-Dimethylglutaric acid* is a white solid which separates from ether and light petroleum in microscopic needles melting at 132—133°.

When this substance is heated with concentrated hydrochloric acid, it is in part converted into *αβ-dimethylglutarimide*,



$CH_2\cdot CH<\begin{matrix}CH(CH_3)\cdot CO\\ CH_2\text{———}CO\end{matrix}>NH$, which crystallises from water in long needles melting at 113°, and in part into trans-*αβ-dimethylglutaric acid*, which appears to be a liquid at the ordinary temperature.

The imide, on hydrolysis with sulphuric acid, yields cis-*αβ-dimethylglutaric acid*, which crystallises from concentrated hydrochloric acid in needles melting at 87°.

The *trans*-acid is unacted upon by acetyl chloride, but when boiled with acetic anhydride or when slowly distilled under atmospheric pressure it is converted into the *anhydride* of the *cis*-acid, which may also be prepared by the action of acetyl chloride on the *cis*-acid. It is a liquid boiling at 255° (765 mm.). The *anilic acid* separates from dilute alcohol in lustrous plates melting at 149°. The *cis*-acid, on heating in a sealed tube with concentrated hydrochloric acid, is converted into a mixture of the *cis*- and *trans*-acids.

The authors described the preparation of *αβ-dimethylpropanetricarboxylic acid*, $(CO_2H)_2{:}C(CH_3){\cdot}CH(CH_3){\cdot}CH_2{\cdot}CO_2H$, which crystallises from dilute hydrochloric acid in white needles melting with evolution of carbon dioxide at 165°. When heated to 200°, this acid is converted into a mixture of *cis*- and *trans-αβ*-dimethylglutaric acids.

The *cis*- and *trans*-forms of substituted glutaric acids may be separated by converting the mixed acids into their ammonium salts and heating them in a sealed tube at 160° for 4 hours. In this way, the ammonium salt of the *cis*-acid is converted into the imide, which, on hydrolysis with sulphuric acid, yields the *cis*-acid, whilst the *trans*-ammonium salt remains unchanged. The imide and ammonium salt are separated by means of ether.

The separation of *cis*- and *trans-αα′*-dimethylglutaric acids, of *cis*- and *trans-α*-methyl-*β*-*iso*propylglutaric acid, and of *cis*- and *trans*-*αα′ββ*-tetramethylglutaric acids have been thus effected.

*186. "Constitution of metallic cyanides." By J. E. Marsh.

Volhard (*Annalen*, 1890, **259**, 378) has shown that potassium cyanide is oxidised by potassium permanganate to potassium cyanate. Other cyanides are similarly oxidised. Ammonium cyanide is thus converted directly into urea. There are two exceptions among metallic cyanides; silver and mercury cyanides are not oxidised by potassium permanganate. This reaction brings the cyanides of silver and mercury into relationship with the nitriles, which are also unattacked. On the other hand, the other cyanides are brought into association with the readily oxidisable carbamines. The author thinks that silver cyanide should be represented as $Ag{\cdot}C{\vdots}N$, and potassium cyanide as $K{\cdot}N{:}C$.

DISCUSSION.

Dr. WADE said he thought it was unsafe to infer a difference in the constitution of potassium and silver cyanides from the difference in behaviour of these salts towards oxidising agents. The potassium salt is freely ionised in aqueous solution, whilst the silver salt is insoluble and not appreciably ionisable; the stability of the latter towards oxidising agents is thus explained without having recourse to the hypothesis of a nitrilic constitution. Potassium cyanide resembles the alkyl *iso*cyanides in readily undergoing oxidation, as in most other respects (*Trans.*, 1902, **81**, 1606), but its ready ionisability in this case destroys the parallel; the products of the oxidation of the undissociated alkyl *iso*-cyanides are complex and not comparable with the alkali cyanates, which are formed by the oxidation of *iso*-cyanogen ions.

*187. "Auto-reduction of mercury and silver cyanides." By J. E. Marsh and R. de J. F. Struthers.

On the hypothesis that silver and mercury cyanides have the nitrile constitution, attempts have been made to bring about the hydrolysis of the (CN) group, if possible without breaking off the metal. In all the reactions tried in which the (CN) group is hydrolysed, it is broken off from the metal.

When mercuric cyanide is heated with a strong solution of potassium hydroxide, the salt is reduced to metallic mercury. The same reduction is brought about by boiling the salt with a solution of sodium or potassium hydroxide or ethylate in excess of alcohol. Cyanide and cyanate of the alkali are formed. The alkali cyanide formed protects the mercury salt from reduction, so that only half of the mercury is reduced. If potassium cyanide be previously mixed with the mercury salt, no reduction occurs. An intermediate product is being further investigated. Silver cyanide is also reduced in the same way.

When mercury cyanide is heated with from sixty to eighty times its weight of a mixture of equal volumes of sulphuric acid and water, hydrogen cyanide and carbon dioxide are evolved at about 130° and the whole mass sets to a jelly, from which mercurous sulphate is obtained on filtration; ammonium sulphate is also formed. The decomposition of the cyanide may be represented thus: $2HgC_2N_2 + 2H_2O + H_2SO_4 = Hg_2SO_4 + 3HCN + CO_2 + NH_3$. The decomposition of the cyanide is, however, not complete, and if the temperature is allowed to rise above 140°, whether the precipitate is previously removed or not, a further reduction takes place, with separation of metallic mercury. If mercury cyanide is heated with water in a sealed tube, the salt is completely decomposed, giving mercury, carbon monoxide, and ammonium carbonate. The reaction begins below 230° and may be thus expressed $HgC_2N_2 + 4H_2O = Hg + CO + (NH_4)_2CO_3$. No oxalic acid was obtained, but it was found that ammonium oxalate, under the same conditions, breaks up into carbon monoxide and ammonium carbonate. Silver cyanide is also reduced to metallic silver when heated with water.

188. "Note on the action of acids on cellulose." By Miss M. Gostling, B.Sc.

In previous communications it has been shown that all forms of cellulose, when heated to about 80° with a saturated solution of hydrochloric or hydrobromic acid in chloroform or carbon tetrachloride, yield ω-chlorobromomethylfurfural, and that dextrose (which could be extracted with water after separation of the methyl furfural derivative) was formed at the same time. Hence the presence of a ketose as well as an aldose nucleus in cellulose was conclusively proved.

In every case, about 40 per cent. of a black residue which retained the fibrous structure of the original cellulose was left after the action of the acids.

In the hope of throwing further light on the constitution of cellulose, the nature of this residue was investigated, and it was prepared free from any of the original cellulose by repeated treatment with hydrochloric acid until no more of the furfural derivative was formed.

Chlorine acted very slowly on this black residue, giving yellow derivatives containing from 25·7 to 34·35 per cent. of chlorine.

The action of bromine was similar.

Nitric acid (sp. gr. 1·2) and alkaline permanganate oxidise it to oxalic acid.

The original black residue is quite insoluble in alkalis, water, alcohol, ether, and other organic solvents.

The composition and general character of this residue is therefore closely allied to the substances known as artificial humus, obtained by Conrad and Guthzeit and by Sestini by the action of dilute acids on sugars. It corresponds most nearly with sacculmin (prepared by Sestini by boiling cane sugar with dilute sulphuric acid), which was a black, amorphous mass, insoluble in potash solution, giving, with chlorine, yellow chlorine compounds. Sestini gives to sacculmin the formula $C_{44}H_{38}O_{15}$ ($C = 65·5$; $H = 4·8$ per cent.), a slightly higher percentage of carbon and hydrogen than that in the black residue from cellulose (found $C = 62·31$ to $62·70$; $H = 3·64$ to $4·29$).

189. "Nitrotartaric acid and some of its ethereal salts." By P. F. Frankland, H. L. Heathcote, B.Sc., and Miss H. Hartle, B.Sc.

The announcement in the current number (Dec. 6th) of the *Berichte* that a paper is to be communicated to the Berlin Society on Dec. 8th by Professor P. Walden on the nitromalic and nitrotartaric esters, compels the authors to publish without delay the results of work on which they have been engaged during the past four years.

Their investigation has included the preparation and characterisation of the following compounds: dinitrotartaric acid, dimethyl dinitrotartrate, diethyl dinitrotartrate, dimethyl mononitrotartrate, and diethyl mononitrotartrate. Of these, dinitrotartaric acid was first obtained by Reinsch (*Jahrb.*, 1849, 329) and Dessaignes (*Jahrb.*, 1852, 475), whilst Henry (*Ber.*, 1870, **3**, 530) professes to have prepared diethyl dinitrotartrate; the other compounds are, as far as the authors are aware, described for the first time. The only reference to the optical properties which they have been able to discover in chemical literature is the statement by Dessaignes that Chautard had found dinitrotartaric acid to be optically active and dinitroracemic acid inactive. With regard to diethyl dinitrotartrate, the authors are of opinion that Henry must have been dealing with the mononitrotartrate, inasmuch as he gives no analysis, and the melting point 45—46°, which he records is very different from that which the authors have found, 27°, for the dinitro-, but very similar to that, 47°, which they have found for the mononitro-compound.

The authors have determined the optical activity of all these compounds dissolved in methyl and in ethyl alcohol, and, except in the case of dinitrotartaric acid, in benzene also.

The influence on the optical activity of the introduction of the nitro-group into the molecules concerned was also discussed.

190. "The nitration diethyl monobenzoyl- and mono-*p*-toluyltartrates." By P. F. Frankland, H. L. Heathcote, B.Sc., and C. J. Green, M.Sc.

For the reasons given in the preceding abstract, the authors wish to communicate the results which they have obtained in this investigation, which was also commenced four years ago.

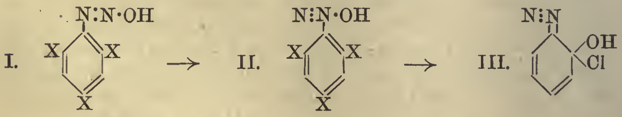
Diethyl mono-benzoyltartrate and mono-*p*-toluyltartrate were nitrated in the cold in the hope of obtaining their mono-nitrates. In both cases, however, only compounds in which the nitro-group had entered the benzene ring were obtained. By hydrolysis it was shown that the *m*-nitrobenzoyl group was present in the one case, and the nitro-*p*-toluyl group ($CH_3 : NO_2 : CO = 1 : 2 : 4$) in the other.

The rotation of these compounds was determined in solution in ethyl alcohol, ethyl acetate, benzene, pyridine, and chloroform. Their optical activity was enormously influenced by the solvent, thus the mono-*m*-nitrobenzoyl compound was inactive in benzene, although it exhibited considerable activity in the other solvents employed.

191. "Interchange of halogen for hydroxyl in chloro- and bromonaphthalenediazonium hydroxides. Preliminary notice." By K. J. P. Orton.

It has recently been shown by the author that *s*-trichloro- and *s*-tribromo-benzenediazonium compounds undergo a remarkable isomeric change under certain conditions. If aqueous solutions of such salts as the diazonium nitrate or hydrogen sulphate are kept for a short time, the presence of chloride may soon be recognised by means of silver nitrate; at the same time, the solution becomes yellow, owing to the formation of the *o*-diazophenol (*o*-diazoquinone) The salts of a weak acid, such as the acetate, undergo the same change far more rapidly.

These facts lead to the conclusion that this change is a transformation of the diazonium hydroxide, $C_6H_2X_3{\cdot}N(OH){\vdots}N$, formed by hydrolytic dissociation; the weaker the acid, the larger would be the proportion of the diazonium hydroxide present at any one time, and consequently the more rapid the change. Moreover, the presence of a sufficient excess of acid stops the change. Treatment with excess of alkali (hydroxide or carbonate), on the other hand, does not effect the elimination of halogen, but merely converts the diazonium compound, $C_6H_2X_3{\cdot}N(A){\vdots}N$, into the diazotate (*iso*- or *anti*-diazotate), $C_6H_2X_3{\cdot}N{:}N{\cdot}OM'$. If dilute acid is cautiously added to a solution of the diazotate, halogen is also eliminated. On treatment with acid, the alkali diazotate should first of all yield the corresponding acid, the diazohydrate, $C_6H_2X_3{\cdot}N{:}N{\cdot}OH$, but, as is well known, these acids appear to change immediately into neutral substances, probably primary nitrosoamines. In the reaction here described, it would seem that the diazo-hydrate (I) is either transformed into the diazonium hydroxide (II) (or its ions), and then into a complex (III) of the quinone type, or else directly into this complex; from this quinonoid



compound, hydrogen chloride (or bromide) is eliminated, and a diazoquinone produced, or the halogen wanders to the nitrogen, a phenol diazonium salt being formed.

As the tendency to pass into the quinone type seems to be greater in the naphthalene series than in the benzene series, it would be expected that this transformation would take place with greater readiness in the case of naphthalenediazonium compounds. Meldola and Streatfeild (*Trans.*, 1895, **67**, 908), who first observed this type of replacement of bromine by hydroxyl, have obtained 4-bromo-2-diazo-1-naphthol by treatment of 1 : 4-dibromo-2-naphthylamine, dissolved in acetic acid, with sodium nitrite, and subsequent boiling of the mixture with water. The author has studied the transformation of chloro- and bromo-naphthalenediazonium hydroxides, the solid salts of which have not hitherto been prepared.

1-*Chloro-2-naphthalenediazonium hydrogen sulphate*, $C_{10}H_6Cl\cdot N(SO_4H){\vdots}N$, prepared from 1-chloro-2-naphthylamine, can be obtained (but with considerable difficulty) in the form of colourless needles, very soluble in water and acetic acid and moderately so in methyl alcohol. Exposed to the air, the crystals become yellow in a few minutes. The aqueous solution of the hydrogen sulphate, which is of course strongly acid, very rapidly becomes yellow and turbid. In the presence of sodium acetate, the change was complete in a few hours, and 2-diazo-1-naphthol (2-diazo-1-naphthoquinone), $O{:}C_{10}H_6{:}N_2$, had separated in long, slender, golden-yellow needles (m. p. 76—77°); at the same time, a small quantity of an amorphous, yellow solid containing chlorine was formed; it is probably an azo-condensation product. The chloride formed in the solution fell but little short of that contained in the diazonium salt. On passing dry hydrogen chloride into an ethereal solution of the diazonaphthol, a nearly colourless, crystalline *hydrochloride* is obtained.

2 : 4-*Dibromo*-1-*naphthalenediazonium hydrogen sulphate*,

$$C_{10}H_5Br_2\cdot N(SO_4H){\vdots}N,$$

crystallises in colourless needles which are considerably more stable than the β-naphthalene derivative just described (compare Knoevenagel, *Ber.*, 1895, **28**, 2052). The aqueous solution of this salt rapidly becomes yellow, and after a short time begins to deposit the diazonaphthol in small rosettes of needles. In the presence of sodium acetate, the diazonium salt is completely decomposed in 24 hours, one atomic proportion of bromine being found in the solution. 4-*Bromo*-1-*diazo*-2-*naphthol* (4-*bromo*-1-*diazo*-2-*naphthoquinone*), $O{:}C_{10}H_5Br{:}N_2$, crystallises from dilute alcohol in rosettes of bright yellow needles, which melt and decompose with evolution of gas at 132—133°; it yields a nearly colourless *hydrochloride*.

192. "Purpurogallin." By A. G. Perkin and A. B. Steven.

The discovery of Nietzki and Steinmann (*Ber.*, 1887, **20**, 1277) that purpurogallin, on distillation with zinc dust, yields naphthalene has been confirmed. On methylation, purpurogallin gives a *trimethyl ether*,

$C_{11}H_5O_2(OCH_3)_3$, orange-yellow needles, m. p. 174—177°, which forms a *monoacetyl* derivative, $C_{11}H_4O_2(OCH_3)_3 \cdot C_2H_3O$, needles, m. p. 140—143°, and by the action of alcoholic potash at 170° yields a crystalline acid, m. p. 197—199°. The latter, on distillation, is converted into an anhydride, m. p. 164—166°. By digestion with 50 per cent. potassium hydroxide solution, purpurogallin is converted into two isomeric compounds possessing almost identical reactions, to which the names *purpurogallone* and iso*purpurogallone* have been given. The former, minute yellow needles, m. p. 260—262°, has probably the formula $C_{11}H_6O_5$, and gives the anhydroacetyl compound

$$C_{11}H_2O_4(C_2H_3O)_2,$$

colourless, prismatic needles, m. p. 174—176°, whereas the latter, $C_{11}H_6O_5$, yellow needles melting above 300°, gives, with acetic anhydride, the compound $C_{11}H_2O_4(C_2H_3O)_2$, colourless, prismatic needles, m. p. 280—282°. It is probable that both compounds contain a carboxyl group.

193. "Note on the destructive distillation of ethyl gallate." By A. G. Perkin.

According to Schiff (*Annalen*, 1872, **163**, 217), on distillation, ethyl gallate gives pyrogallol and ethyl alcohol. This is so, but at the same time, towards the end of the operation, a considerable quantity of a red colouring matter sublimes, which has been identified as *rufigallic acid* (hexahydroxyanthraquinone) (found, C = 55·14; H = 2·63), by its acetyl derivative, $C_{14}H_2O_4(C_2H_3O)_6$ (found, C = 55·78; H = 3·85; $C_{14}H_8O_4$ = 55·09), m. p. 282—283° (not previously given), and by its dyeing properties. The yield was approximately 7 per cent., but considerable carbonisation occurs when this colouring matter is distilled. The reaction may be expressed as $2C_6H_2(OH)_3 \cdot CO_2Et = C_{14}H_8O_8 + 2EtOH$. Gallic acid itself, on distillation, yields a small quantity of the same substance (acetyl compound, C = 56·17; H = 3·77), whilst protocatechuic acid and its ethyl salt give a trace of a colouring matter resembling rufiopin. β-Resorcylic acid does not give rise in this way to any anthraquinone derivative.

194 "A series of double chromates." By S. H. C. Briggs.

The author has found that freshly precipitated copper hydroxide or carbonate dissolves in one equivalent of chromic acid to give a clear solution in the presence of twenty or thirty equivalents of copper sulphate, or ten to fifteen equivalents of copper silicofluoride, although in the absence of these salts the dichromate and a precipitate of basic salt are produced.

A double salt, $(NH_4)_2Ni(CrO_4)_2,6H_2O$, was obtained by adding ammonium chromate to a solution of a nickel salt. This could be recrystallised from water below 40°, although nickel chromate has never been obtained from aqueous solution, and ammonium chromate can only be recrystallised from solutions containing ammonia. Attempts to prepare the potassium nickel chromate and double chromates of ammonium and copper, zinc, cadmium, and manganese were unsuccessful.

By the action of ammonia on the mother liquors from the preparation of $(NH_4)_2Ni(CrO_4)_2,6H_2O$ from the chloride, a double salt, $(NH_4)_2Ni(CrO_4)_2,2NH_3$, was obtained, and corresponding copper, zinc, and cadmium compounds were formed by the action of ammonia on the dichromates. These double salts, on heating, lose water and ammonia, and undergo sudden decomposition between 200° and 300°, leaving a mixture of oxides.

ADDITIONS TO THE LIBRARY.

I. Donations.

Naylor, William. Trades waste: its treatment and utilisation with special reference to the prevention of rivers pollution. A hand-book for borough engineers, surveyors, architects, and analysts. Pp. xvi, 267, ill. London 1902. From the Author.

Blochmann, Reinhart. Guide to preparation work in inorganic chemistry for students of chemistry and pharmacy. Authorised translation by James Lewis Howe. Pp. viii, 74, ill. Lexington, Va. 1902. From the Translator.

Moureu, Ch. Notions fondamentales de chimie organique. Pp. 292. Paris 1902. From the Author.

Ronna, A. Rothamsted: un demi-siècle d'expériences agronomiques de MM. Lawes et Gilbert. Pp. vi, 607. Paris 1900. From the Lawes Trust

Krauch, C. The testing of chemical reagents for purity. Authorised translation of the third edition by J. A. Williamson and L. W. Dupré. With additions and emendations by the author. Pp. 350. London [1902]. From the Publishers.

Warington, Robert. The chemistry of the farm. Fifteenth edition (fourth revision). London 1902. From the Author.

London County Council. Bacterial treatment of crude sewage. Fourth report by Dr. Clowes. London 1902. From Dr. Clowes.

New South Wales, Technological Museum. A research on the Eucalypts, especially in regard to their essential oils. By Richard T. Baker and Henry G. Smith. (*Being* No. 13 *Technical Education Series*). Sydney 1902. From the Authors.

III. Pamphlets.

Meyerhoffer, Wilhelm. Die chemisch-physikalische Beschaffenheit der Heilquellen. Pp. 32. Hamburg 1902.

Hantzsch, Arthur Rudolf. Die Diazoverbindungen. Stuttgart 1902. (Sammlung. Vol. viii.)

Hollandsche Maatschappij der Wetenschappen. Herdenking van het hondervijftigjarig bestaan op 7 Juni, 1902. 's Gravenhage 1902.

Hall, A. D., and F. J. Plymen. S.E. Agricultural College, Wye. First Report to the Technical Education Committees of Kent and Surrey on a chemical and physical study of the soils of Kent and Surrey. Ashford 1902.

At the next ordinary meeting on **Wednesday**, January 21st, 1903, at **5.30** p.m., the following papers will be communicated:

"Phenocyclo*heptene.*" By F. S. Kipping and A. E. Hunter.

"The absorption spectra of laudanine and laudanosine in relation to their chemical constitution." By J. J. Dobbie and A. Lauder.

"The relation between the absorption spectra and the chemical structure of corydaline, berberine, and other alkaloids." By J. J. Dobbie and A. Lauder.

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THE CHEMICAL SOCIETY.

The Chemical Society was founded February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice of the same from the Secretaries.

Every Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications issued during the period of his continuing a Fellow. Fellows are also entitled to the use of the books in the Society's collection, under such restrictions as the Council may deem necessary. They have the privilege of introducing two visitors to Ordinary Meetings of the Society, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

Every Fellow, previous to his admission, is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due on the first day of January of every year. The life composition fee is £30. Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If, however, a Candidate be elected during the month of November or December, he is not called upon to pay any annual subscription for the current year, and is not entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March shall owe two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, ceases to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

PUBLICATIONS OF THE SOCIETY.

The following is a list of the Publications of the Society:

Memoirs and Proceedings, 1841—47, 3 vols.
Quarterly Journal, 1848—62, 14 vols.
Journal, 1863—
Proceedings, 1885—

The Journal and Proceedings are sold to non-Fellows of the Society at a price of £2 and 7/6 per annum respectively. The Society has also issued General Indexes to its publications, 1841—72, price 4/-; 1873—82, price 16/- (11/-, post free, to Fellows); 1883—92, price 21/- (16/-, post free, to Fellows); the Jubilee Volume, 1891, price 6/-; and a volume of Memorial Lectures, 1893—1900, price 7/6.

The Journal, which is issued monthly, contains papers communicated to the Society, Memorial Lectures on the life and work of eminent foreign Fellows deceased, together with abstracts of all papers relating to chemistry and closely connected branches of science published in other journals, British and foreign.

The Proceedings contains a short report of the business at each meeting, and abstracts of all papers presented to the Society. It is usually published within seven days after the meeting. It serves as a medium of publication, not only for the abstracts of papers which subsequently appear in full in the Journal, but also for the publication of short papers and preliminary communications.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have instructed that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. An abstract of each paper should be supplied for insertion in the Proceedings. All papers communicated to the Society, with their illustrative drawings, become the property of the Society, unless stipulation be made to the contrary. Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. The Committee meets twice a year to consider applications for grants, and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

At the last Annual Meeting, March 26th, 1902, the numerical strength of the Society was as follows: 2422 Fellows, 32 Foreign Members.

HONORARY AND FOREIGN MEMBERS.

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Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. S., Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath, Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
Feb. 1, 1883	Beilstein, Prof. Dr. F., W.O., 8th line, No. 17, St. Petersburg
Mar. 1, 1860	Berthelot, Prof. M., Membre de l'Institut, F.R.S., Collège de France, Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. S., F.R.S., Reale Università, Rome
Feb. 1, 1883	Cleve, Prof. Dr. P. T., Universitet, Upsala
Jan. 20, 1898	Curtius, Geh. Rath, Prof. Dr. T., Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. E., Aschaffenburg, Germany
June 16, 1892	Fischer, Geh. Rath, Prof. Dr. Emil, F.R.S., Dorotheenstr. 10, Berlin
Feb. 1, 1883	Fittig, Prof. Dr. R., Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. A. P. N., Rapenburg 104, Leyden
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Université, Geneva
Feb. 2, 1888	Hoff, Prof. Dr. J. H. van't, F.R.S, Uhlandstrasse 2, Charlottenburg, Berlin
Jan. 20, 1898	Körner, Prof. W., R. Scuola superiore d'agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath, Prof. Dr. A., Kaiser Wilhelmstrasse 43, Breslau
Feb. 2, 1888	Landolt, Prof. Dr. H., Albrechtstrasse 14, Berlin, N.W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Wasagasse 9, Vienna
Jan. 20, 1898	Markownikoff, Prof. Dr. W., Universität, Moscow
Feb. 1, 1883	†Mendeléeff, Prof. Dr. D. I., F.R.S., 19 Zabalkansky, St. Petersburg
Jan. 20, 1898	Menschutkin, Prof. Dr. N., Universität, St. Petersburg
Jan. 20, 1898	Moissan, Prof. Henri, Rue Vauquelin 7, Paris
Jan. 20, 1898	Ostwald, Prof. Dr. W., Linnéstrasse 2/3, Leipzig
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.

* Faraday Lecturer, 1872.

† Faraday Lecturer, 1889.

Date of Election.	
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Th., Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. W., Rue Beckmann 32, Liége
May 18, 1876	Thomsen, Prof. Dr. Julius, Universitet, Copenhagen
Jan. 20, 1898	Troost, Prof. L. J., Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. J. D. van der, T.C., Hooftstraat 117, Amsterdam
Feb. 2, 1888	Wislicenus, Geh. Rath Prof. Dr. Johannes, F.R.S., Liebigstr. 18, Leipzig

FARADAY LECTURERS.

1869. J. B. A. Dumas.
1872. S. Cannizzaro.
1875. A. W. von Hofmann.
1879. A. Wurtz.
1881. H. von Helmholtz.
1889. D. Mendeléeff.
1895. Lord Rayleigh.

LONGSTAFF MEDALLISTS.

1881. T. E. Thorpe.
1884. C. O'Sullivan.
1888. W. H. Perkin.
1891. F. R. Japp.
1894. H. T. Brown.
1897. W. Ramsay.
1900. W. H. Perkin, junr.

Any inaccuracies in this list should be reported to The Secretaries, Chemical Society, Burlington House.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society ; V.P. as Vice-President ;
S. as Secretary ; T. as Treasurer ; F.S. as Foreign Secretary ; P. as President.

Date of Election.			
1898			Abbott, Albert, B.A., Church Street, Adlington, Chorley, Lancs.
1848	Trans.	C. 1856-9 62-5 V.P.66-7 F.S. 68-9 T. 69-75 P. 75-7	Abel, Sir F. A., Bart., K.C.B., D.C.L., F.R.S., 2, Whitehall-court, S.W., and the Imperial Institute, Imperial Institute-road, London, S.W.
1871	Trans.	C. 1882-3	Abney, Sir W. de W., Capt., R.E., K.C.B., D.C.L., F.R.S., F.R.A.S., F.R.G.S., Rathmore Lodge, Bolton-gardens South, S.W.
1883			Abraham, Alfred C., 87, Bold Street, Liverpool
1890			‖Abrines, G. Anthony, Waterport-Street, Gibraltar
1875	Trans.		Ackroyd, William, F.I.C., 9, Grandsmere Place, Halifax, Yorks.
1897	Trans.		Acworth, Joseph John, Ph.D., F.I.C., Braeside, Shootup Hill Cricklewood, N.W.
1892			Adams, Arthur, Kelvin House, Edgbaston-road, Smethwick
1888			Adams, Charles M., Albany-buildings, Lord-street, Southport
1877	Trans.		‖Adams, M. A., F.R.C.S., the Kulm, Bearstead, near Maidstone
1901			Adams, O. G., Stawell School of Mines, Victoria, Australia
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helens, Lancs.
1896			Addie, Robert, Calder Park, Baillieston, nr. Glasgow
1889	Trans.		Addyman, F. Thornton, St. George's Hospital, Hyde Park S.W.
1881	Trans.		Adeney, W. E., D.Sc., Royal University of Ireland, Earlsfort Terrace, Dublin
1885	Trans.		Adie, R. Haliburton, B.Sc., M.A., 8, Richmond-road, Cambridge
1885			Adriance, John S., Ph.D., 105, East Thirty-ninth-street, New York, U.S.A.
1885			Aikman, Charles M., M.A., B.Sc., F.R.S.E., F.I.C., 128, Wellington-street, Glasgow
1901			Aitken, A. C., c/o Messrs. Curtis and Harvey, Cliffe nr. Gravesend
1879			Albright, G. Stacey, The Elms, Edgbaston-park-road, Edgbaston, Birmingham

Date of Election.		
1893		Albuquerque, Prof. John Predozod de, Government Laboratory, Barbados, West Indies
1885		Alcock, Frank Harris, 9, Broad-street Corner, Birmingham
1892		Alcock, John W. Central Brewery, 45, Mott-street, Birmingham
1888	Proc.	Alexander, John, M.A., Midfield, Perth
1897		Alexander, J. Owen, 39, Mincing-lane, E.C.
1882		Alford, Henry James, M.D., 1, Hovelands-terrace, Taunton
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, Salford Sugar Refinery, and 57, Mabfield-road, Fallowfield, Manchester
1864	Trans.	‖Allen, Alfred Henry, 8, Broomfield-road, Sheffield
1894		Allen, F. J., Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, F. T., B.Sc., Higher Grade School, Carlisle
1891		Allen, George James, Chemical Laboratory, 55 and 56, Barton Arcade, Manchester
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1894	Trans.	Allhusen, F. E., Beadnell Tower, Chathill, Northumberland
1894		Allibon, G. H., 30, Donegal-place, Belfast
1899		Allworthy, J. H., Paston Grammar School, North Walsham, Norfolk
1899		‖Allworthy, S. W., M.A., M.D., The Manor House, Antrim Road, Belfast.
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. Oxon., M.R.I., 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc., 65 Palace Gardens Terrace, Bayswater, W.
1895		Anderson, H., Royal Latin School, Buckingham
1900		Anderson, J. W., 1, Preston Villas, Halling, Kent
1901		Anderson, W. C., M.A., D.Sc., 2, Florentine Gardens, Hillhead, Glasgow
1892		Anderson, William Smellie, Christmas Island, c/o Messrs. Bousfield & Co., Singapore
1888		Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882		Andrews, L. W., Ph.D., The University, Iowa City, Iowa, U.S.A.
1870		Andrews, Thomas, F.R.S., M.I.C.E., Ravencrag, Wortley, near Sheffield
1877		Angell, John, 6, Beacon's Field, Derby-road, Withington, Manchester
1898		Annable, H. W. Coupe-, 258, Queen's-road, Battersea, S.W.
1876		Ansdell, Gerrard, 3, Cross-lane, St. Mary-at-Hill, E.C.
1879		Appleby, Herbert, 2, John Dalton Street, Manchester

Date of Election.			
1890	Trans.		Appleyard, James Robert, Royal Technical Institute, Salford
1897	Trans.		Arbuckle, William, 20, Albemarle Street, W.
1884			Archbutt, Leonard, The Yews, Madeley-street, Derby
1875			Armistead, William, M.B., C.M., Stapleford, Cambridge
1881			Armitage, Charles, Lancaster Corporation Gas Works, Lancaster
1900	Proc.		Armitage, F. P., Colet House, Talgarth-road, W. Kensington, W.
1900			Armstrong, F. W., The Grammar School, Market Bosworth
1870	Trans.	C.1873-4 S. 1875-93 P.1893-5	‖Armstrong, Henry E. Prof,, LL.D., Ph.D., F.R.S., 55, Granville Park, Lewisham, S.E., and Central Technical College, Exhibition-road, London, S.W.
1894			Ashcroft, J. B., Christ Church Schools, Derby
1894			Ashdown, Charles H., F.R.G.S., Monastery-close, St. Alban's
1884			Ashe, William Percy, M.D., 17, Alexander-square, S.W.
1900			Ashton, James, Hacken Sewage Works, Moses Gate, Bolton
1897			Ashworth, J. B., Bridge Cottage, Broad Green, Liverpool
1900			Aston, B. C., N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, W. G., 12, Douglas-road, Goodmayes, Ilford, E.
1901			Aspinall, Thos., 42, Gilnow-road, Bolton
1899			Atkinson, G. D., c/o Messrs. Crowley & Co., The Brewery, Alton, Hants
1872	Trans.		‖Atkinson, R. W., B.Sc., 44, Stuart Street, Cardiff
1862	Trans.	C. 1874-7	‖Attfield, Prof. John, F.R.S., 111, Temple-chambers, E.C., and Ashlands, Watford, Herts
1872	Trans.		‖Attwood, George, F.G.S., A.M.I.C.E., Durmast Lodge, Ringwood, Hants, and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1895	Trans.		‖Auden, H. A., Municipal Technical Institute, Romford-road, West Ham, E.
1886			Audley, James A., B.Sc., A.R.C.Sc., F.I.C., 1, St. Winifrede's Gardens, Shrewsbury
1877			Austen, Peter T., Ph.D., 218, St. John's-place, Brooklyn, N.Y., U.S.A.
1892			Avery, David, 3, Belmont-avenue, Kew, Melbourne
1896			Aykroyd, H. E., Glen Rosa, The Grove, Ilkley, Yorks.
1891			Aylan, John Charles, Manager Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1875	Trans.		‖Bailey, G. H., Ph.D., D.Sc., Owens College, Manchester, and Marple Cottage, Marple, Cheshire.
1895			Bailey, G. P., M.A., Professor of Chemistry, Stonyhurst College near Blackburn.
1893			Bailey, Henry, 18, Lavender-sweep, S.W.

Date of Election.			
1898			Bailey, W. M., M.A., Penrhyn, Ty'rfran, Llanelly
1900			Bain, A. W., B.A., 2, Muswell Rise, Highgate, N.
1884			‖Bain, Daniel, Allhuisen's Works, United Alkali Co., Gateshead
1891			Bairstow, John, Burley, Queen's Park, Chester
1901			Baker, Arthur, 130, Walmersley-road, Bury, Lancs.
1889			‖Baker, Charles Frederic, B.Sc., Ph.D., Technical College, Sunderland
1883	Trans.		‖Baker, Charles J., The Schools, Shrewsbury
1899			Baker, C. H., 70, Blenheim-road, Moseley
1900			Baker, F. Nolan, Lieut., Royal Artillery Barracks, Woolwich
1881	Trans.		Baker, Harry, Epworth House, Maughland-lane, Runcorn, Cheshire
1884	Trans.	C. 1899-	‖Baker, H. Brereton, M.A., Dulwich College, S.E.
1893	Trans.		Baker, Julian L., 7, Addison-road, Bedford Park, W.
1901			Baker, T. T., 28, Church-road, Forest Hill, S.E.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon, Surrey
1897			Ball, John, Ph.D., F.G.S., A.M.I.C.E., Geological Survey Office, Public Works Department, Cairo, Egypt
1897			Ball, William, 54, Stretton-road, Leicester
1901	Proc.		Ball, W. C., B.A., Guy's Hospital, S.E.
1892			Ballantyne, Horatio, 75, Chancery-lane, W.C.
1884			Ballard, J. Farrow, Fern Lodge, Trinity-road, Birchfield, Birmingham
1896			Ballingall, William, Ardarrock, Dundee
1891			Baly, Edward C. Cyril, University College, W.C.
1886			Bamber, H. K. G., c/o Messrs. Knight, Bevan, and Sturge, Northfleet
1890			Bamber, M. Kelway, Hatton, Ceylon
1896			Banerjee, Gopal Ch., Kaiser Soap Co., Cawnpore, India
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, 59, Tregunter-road, S. Kensington, S.W.
1880			Barclay, Arthur E., 95, Farringdon-street, E.C.
1897			Barclay, John, B.Sc., Osmotherley Cottage, Linthurst, Worcestershire
1877			Bardsley, J., F.I.C., Milnshaw House, Accrington, Lancashire
1901			Barker, H. H., 3, Waverley-place, St. John's Wood, N.W.
1896			Barker, W. H., B.Sc., The Acton and Chiswick Polytechnic, Bedford Park, W.
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1894			Barlet, Stéphane, B.Sc., 47, Bassett-road, N. Kensington, W.
1897			Barlow, H. W. L., M.A., M.B., Oxon, Holly Bank, Croftsbank-road, Urmston, Manchester
1897			Barlow, W. H., 152, Osbaldestone-road, Stoke Newington, N.
1897			Barlow, William, The Red House, Stanmore, Middlesex.

Date of Election.			
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W., and Dynamite Works, Zuurfontein, S.A.R.
1875			‖Barnes, R. L., Phœnix Chemical Works, Hackney Wick, N.E.
1888			Barraclough, William H., F.I.C., Mortomley, near Sheffield
1895			Barralet, E. S., c/o Messrs. W. Burton & Sons, 2, Green-street, Bethnal Green, E.
1891			Barratt, J. Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward L., B.Sc., 12 Avenue de la Grande Armée, Paris
1901			Barrie, T. S., 157, St. Vincent-street, Glasgow
1892	Trans.		‖Barrows, Arthur Edward, Bloomfield Iron Works, Tipton, Staffordshire
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, J. A., Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc., Ph.D., University of North Carolina, Chapel Hill, N.C., U.S.A.
1864	Trans.	{C. 1870-2, 90-3}	‖Bassett, Henry, 26, Belitha-villas, Barnsbury, N.
1891			Bate, William, National Explosives Co., Hayle, Cornwall
1893			Bateman, John, Messrs. J. C. and J. Field, The Marsh, Lambeth, S.E.
1896			Bathurst, Charles, jun., B.A., 3, Stone-buildings, Lincoln's Inn, W.C.
1900			Battle, G. E., B.A., Totlands, Dane Park, Ramsgate
1896			Bay, L. H., The Grammar School, Carlisle
1892			Bayliss, Charles, Ellesmere, Selly Park, near Birmingham
1874			Bayly, F. W., The Royal Mint, Sydney, N.S.W.
1874			‖Bayne, James, Professor, Royal Veterinary College, Camden Town, N.W.
1879			‖Bayne, William Thirlwall, LL.D., Brockhill, Broad Clyst, Exeter
1873			Baynes, James, Ph.D., F.R.M.S., Borough Analyst's Office, Royal Chambers, Scale-lane, Hull
1897			Beadle, A. A., Greenheys, Granville-road, High Barnet
1891	Trans.		Beadle, Clayton, Melrose, Hatherley Crescent, Sidcup
1861			‖Beadnell, Major Charles Edward, R.A., Fernside, Redhill, Surrey
1867			Beale, William Phipson, K.C., 10, New-court, Carey-street, Lincoln's-inn, W.C.; and 25, Sheffield-terrace, Kensington, W.
1899			Bean, Percy, 17, Dickinson-street, Manchester
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, G. Russell, D.P.H. Camb., L.R.C.P. Lond., M.R.C.S. Eng., L.S.A., Warwick House, Upper-street, Islington, N.
1887			Beasley, William C. T., M.A., Türkenstrasse, 19, München
1901			Beaven, E. S., 5, Borcham-terrace, Warminster
1890	Trans.		Beck, Charles R., 33, Grosvenor-street, Coventry
1874			‖Beckett, George Henry, Glendye Cottage, Stevenston, Ayrshire, N.B.

Date of Election.			
1901			Bedford, F., B.Sc., 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, P. Phillips, Prof., D.Sc., M.A., Durham College of Science, Newcastle-on-Tyne
1901			Bedwell, J. C., B.Sc., 65, High-street, Colchester
1900			Beesley, F. A., B.Sc., Bank House, Wirksworth, Derby
1872	Trans.		‖Beilby, George T., St. Kitts, Slateford, N.B.
1891			Belbin, T. St. J., Nortonthorpe Hall, near Huddersfield
1888			Belcher, John Hope, B.A., B.Sc., Municipal Technical Institute, Coventry
1891			Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester A., B.A., M.B. (Dublin), 3, Mansfield-place, Richmond, Surrey
1889			Bell, E. Wightman, High Bridge, Spalding
1899			Bell, H. P., B.A., 30, Egerton-crescent, S.W.
1865	Trans.		‖Bell, J. Carter, the Cliff, Higher Broughton, Manchester
1863	Trans.		Bell, Sir I. Lowthian, Bart., F.R.S., Rounton Grange, Northallerton
1889			‖Bell, Percy Carter, 150, Nassau-street, New York, U.S.A.
1879			Bemrose, Joseph, 56, St. Famille-street, Montreal, Canada
1874			‖Bendix, David, Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1874			Benger, Frederick Baden, F.I.C., The Grange, Knutsford, Cheshire
1902			Benham, K. B., Dean's Hill, Stafford
1881			‖Benjamin, Marcus, M.A., Ph.D., U.S. National Museum, Washington, D.C., U.S.A.
1900			Bennett, A. H., c/o Messrs. Ogston & Moore, 39, Lime-street, E.C.
1900			Bennett, G. L., Rev., M.A., 13, St. Domingo Vale, Everton, Liverpool
1899			Bennetts, B. H., Queenstown, Tasmania
1892	Trans.		Bensusan, Arthur J., c/o A. Halford, Esq., 7, Pembridge-square, W.
1896			Bentley, W. H., B.Sc., 3, Woodbine-terrace, Irlam, near Manchester
1890			Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1883			‖Beringer, Cornelius,
1900			Beringer, H. R., 11, Dolcoathe-road, Camborne, Cornwall
1882			‖Beringer, John J., Pendarves-road, Camborne, Cornwall
1895			Berkeley, The Earl of, Foscumbe, Boar's Hill, Oxford
1890			‖Berncastle, Richard, 22, Aldridge-road Villas, Bayswater, W.
1893			Berridge, Douglas J. P., M.A. Oxon, The Laboratory, Malvern College
1882			‖Berry, Edward E., 44, London Wall, E.C.
1899			Berry, R. A., 5, St. Mary's Passage, Cambridge

Date of Election.			
1891			Berry, Thomas William, Lyndhurst, Stone, Staffordshire
1888			Berry, William, 7, Hampton-park, Redland, Bristol
1883	Trans.	C. 1898-1900	Bevan, Edward J., 4, New-court, Lincoln's-inn, W.C.
1886			Bevan, John William, Risedale, St. James-crescent, Swansea
1897			Bhaduri, J. B., M.A., Dist Nadia, Krishnaghur, Bengal, India
1865			‖Bickerdike, W. E., Bryers Croft, Wilpshire, near Blackburn
1875			Biggart, J. W., Chemical Laboratory, 29, Cathcart-street, Greenock
1872			Biggs, C. H. W., 140, Salisbury-court, Fleet-street, E.C.
1900			Bilimoria, H. N., M.A., B.Sc., 28, Wellington-street, Bombay
1881			Bingley, John, Northampton
1900			Binks, F. N., 201, Ellesmere-road, Benwell, Newcastle-on-Tyne
1894			Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898			Birkett, Walter, 23, Carline-road, Lincoln.
1875	Trans.		Bischof, Gustav, Prof., 9, Hythe-road, Willesden Junction, N.W.
1879			‖Black, A. H., F.R.G.S., St. John's, Wakefield
1902			Black, W. G., 9, Routh-road, Wandsworth Common, S.W.
1886			Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1879			Blackett, Cuthbert R., Laboratory, Swanston-street, Old County Court, Melbourne
1899			Blackman, W. L., Mostyn, Mount Nod-road, Streatham, S.W.
1899			Blackshaw, J. F., The Midland Dairy Institute, Kingston Fields, Derby.
1885			Blades, Chas. Mountain, Bay Villa, Chester-road, Northwich, Cheshire
1883			Blair, Frank A., City Chambers, Darley-street, Liverpool
1901			Blake, G. S., 42, Cromford-road, West Hill, Wandsworth, S.W.
1890	Trans.		Blake, Robert R. F., Chemical Department, Queen's College, Belfast
1890			Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne.
1875			‖Blanshard, Charles Thomas, M.A., F.I.C., 3, Seymour Villas, Totnes
1892			Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1890			Blenkinsopp, W. E. B., c/o May and Baker, Ltd., Garden Wharf, Church Road, Battersea, S.W.
1899			Blofeld, Stuart, B.A., B.Sc., St. Mark's College, Chelsea, S.W.
1896			‖Blood, Maurice, M.A., 9, Clifton-road, Kingston Hill, Kingston on-Thames
1891			Bloomer, Frederick John, F.I.C., Penpont, Clydach R.S.O., Glamorgan
1890	Trans.		Blount, Bertram, Laboratory, Broadway, Westminster, S.W.
1888			Bloxam, Arthur G., F.I.C., Birkbeck Bank Chas., Chancery-lane, W.C.

Date of Election.		
1883	Trans.	Bloxam, W. Popplewell, Prof., B.Sc., F.I.C., Presidency College, Madras.
1887		Blundstone, Edwin Richardson, B.A., Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, T. P., M.A., Tower-place, Shrewsbury
1896		Blyde, J. E. A., 55 Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S., 29, Norfolk-road, N.W.
1892		Blyth, M. Wynter, B.A., B.Sc., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, A., Chemical Works, Stratford, London, E., and Highstanding, Loughton, Essex
1899		Boardman, T. H., Blairlodge School, Polmont Station, Stirlingshire, N.B.
1878		Bodmer, Richard, Analytical Laboratory, 16, Southwark-street, London, S.E.
1899		Bogert, M. T., B.A., Columbia University, Amsterdam Avenue, and 116th-street, New York City, U.S.A.
1899		Bolam, R. A., M.D., 3, Savile-place, Newcastle-on-Tyne
1869	Trans.	‖Bolas, Thomas, 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, E. R., 14A, Selwood-terrace, S.W.
1899		‖Bond, A. E., Princes Chambers, Corporation-street, Birmingham
1883		Bond, Henry C., M.A., Bromley Park School, Bromley, Kent
1893	Trans.	Bone, William Arthur, D.Sc., Ph.D., Owens College, Manchester
1893		Boone, W. T., B.Sc., 6, Sydenham-villas, Cheltenham
1884		Borland, W. D., Beacon Lodge, Green St. Green, nr. Dartford, Kent
1881		‖Borns, Henry, Ph.D., 19, Alexandra-road, Wimbledon, S.W.
1895		‖Borradaile, L. A., Selwyn College, Cambridge
1861		‖Bosanquet, R. H. M., F.R.S., c/o Messrs. Castle, Lamb and Storr, Salisbury-square, Fleet-street, E.C.
1894	Proc.	Bose, Prof. Chuni Lal, 24, Mohendro Bose's-lane, Calcutta
1881		Bostock, G. H., Carnmeen Bleaching Works, Newry
1881	Trans.	Bothamley, Charles H., F.I.C., Hurst Knoll, Weston-super-Mare
1887	Trans.	Bott, William, Ph.D., 14, Great Smith-street, Westminster, S.W.
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1871		Bottomley, James, B.A., D.Sc., 220, Lower Broughton-road, Manchester
1869		Bottomley, James T., M.A., F.R.SS. L. & E., 13, University Gardens, Glasgow
1886		Bottomley, W. Beecroft, Prof., Ph.D., 35, Downside-cres., Hampstead, N.W.
1894		Boul, William Good, M.A., LL.D., D.C.L., Tideswell Grammar School, near Buxton

Date of Election.		
1901		Bousfield, E. G. P., St. Swithin, Hendon, N.W.
1891		Bovell, John R., Dodd's Botanical and Experimental Station, Barbados
1865		‖Bowdler, A. C., 20, Bank-terrace, Wellington-street, Blackburn
1888		Bower, Frank, c/o Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, 53, Moss-bank, Higher Crumpsall, Manchester
1899		Bowles, B. H., 53, Dunsmure-road, Stamford Hill, N.
1896		Bowley, J. J., 64, Redcliffe Gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, Spinningfield, Deansgate, Manchester
1862		Bowman, Frederick H., F.R.A.S., F.L.S., F.G.S., Spinningfield, Deansgate, Manchester
1896		‖Bowman, H. L., M.A., 13, Sheffield-gardens, Kensington, W.
1894	Trans.	Boyd, D. R., B.Sc., Ph.D., The Hartley College, Southampton
1901		Boyers, H., 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Woodcote, Chichester
1876		‖Bradley, Nathaniel, Sunnyside, 53, Chapman-street, Hulme, Manchester
1888		Bradshaw, Charles, 10, The Nook, Barber-road, Sheffield
1881		Braga, John Francis, L.S.A., L.A.H., D.P.H., London & Cantab., F.G.S., F.L.S., F.R.G.S., 138, Croydon-road, Anerley, S.E.
1894	Trans.	Brame, J. S. S., Royal Naval College, Greenwich, S.E.
1882		Branson, F. W., 14, Commercial-street, and Wynneholme, Far Headingley, Leeds
1899		Bratby, G. S., Oak Field, Hale, Bowdon, Cheshire
1882	Trans.	Brauner, B., Ph.D., Spálená ulice, 1, Prague, Bohemia
1896		Bray, Daniel, Old Goole, Goole, Yorks.
1898		Brearley, Harry, 53, Bower-road, Sheffield
1883		Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901		Bridges, J. S., B.Sc., 45, Thistlethwaite-road, Clapton, N.E.
1897		Brierley, James, 18 and 19, French-street, Southampton
1890	Trans.	Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston.
1898		Brierley, Joseph, B.Sc., Ashton-road, Failsworth, Manchester
1893	Proc.	Briggs, John Frederick, 14, Week-street, Maidstone.
1883		Briggs, T. Lynton, 188, Central Avenue, Flushing, L.I., U.S.A.
1884		‖Briggs, William, 12, Queen Anne-terrace, Cambridge
1898	Trans.	Brittain, C. E., B.Sc., Grammar School, Normanton, Yorks.
1900		Britten, F. C., B.A., Perin's Grammar School, Alresford, Hants.
1889		Broadbent, Harry, A.I.C., 187, Hyde Park-road, Leeds
1879		‖Broadbent, John J., 14, Cross-street, Exchange, Manchester
1883		Brock, John, J.P., Gwern-Tyno, Colwyn Bay, N. Wales
1893		‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth

Date of Election.			
1884			Brodie, Sir Benjamin V. S., Bart., Brockham Warren, Betchworth
1898			Brooke, Arthur, M.A., Holderness College, Withernsea, East Yorks.
1900			Brooke, C. B., Colne House, Brantham, near Manningtree, Essex
1893			Brooke, Edward, 96, Craven Park-road, Harlesden, N.W.
1900			Brooke, J. R., A.I.C., 37, Mincing-lane, E.C.
1898			Brooks, C. J., c/o Borneo Co., Ltd., Kucking, Sarawak
1886	Trans.		‖Brothers, H. E., B.Sc., F.I.C., 117, Summerfield-crescent, Edgbaston, Birmingham
1897			Brothers, W. M., Beechwood House, Prestwich, near Manchester
1884		C. 1895-8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., F.G.S., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, West Heath House, Northfield, Worcestershire
1867	Trans.	C. 1872-3 V.P. 81-3 90-1 P. 91-3	Brown, A. Crum, Prof., M.D., D.Sc., F.R.S., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, Tannin Extract Works, Station Zelonie Dol, Moscow-Zazan Railway, Russia, and care of Wm. Brown, Heaton-street, Cleckheaton
1873	Trans.	C. 1881-2	‖Brown, Frederic Douglas, Prof., B.Sc., Univ. Col., Auckland, New Zealand
1884			Brown, F. W.,
1892			Brown, George Fitz, The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, G. Noël, Kempley Vicarage, Gloucester
1880			Brown, Henry, Benskin's Brewery, Watford, Herts
1871	Trans.	C. 1883-6 V.P. 94-7	†Brown, H. T., LL.D., F.R.S., 52, Nevern-square, Kensington, W.
1867	Trans.		‖Brown, James Campbell, D.Sc., 8, Abercromby-square, Liverpool
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1897			Brown, J. H., Gas Works, Ilford, Essex
1892			Brown, Reginald B., Uplands, Sanderstead Hill, S. Croydon
1891			Brown, Robert John, M.Sc., The Technical School, Stockport
1884			Brown, William George, Prof., Ph.D., University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, C. E., B.Sc., Christ's Hospital, E.C.
1893			Browne, Frank, Government Civil Hospital, Hong Kong
1873			Brownen, George, Grove Road East, Avon Park, Christchurch, Hants.
1899	Trans.		Browning, K. C., B.A., St. John's College, Cambridge
1890			Brownsword, Frank, Shebbear College, Highampton, North Devon

† Longstaff Medallist, 1894

Date of Election.			
1894	Trans.		Bruce, James, The Technical College, Huddersfield
1895			Bruckmann, G. T., B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1899			‖Brünnich, J. C., Dept. of Agriculture, Brisbane, Queensland
1893	Trans.		‖Brunton, John Dixon, Wire Mill, Musselburgh, near Edinburgh
1877	Trans.		Buch, C. von, 20, Hanover-street, W.
1877	Trans.		Buchanan, J. Y., F.R.S., 10, Moray-place, Edinburgh
1876			‖Buckmaster, C. A., 16, Heathfield-road, Mill-hill Park, Acton, W.
1852	Trans.	{C. 1855-8, 65-6}	‖Buckton, G. B., F.R.S., Weycombe, Haslemere, Surrey
1878			Budden, E. Russell, 28, Church-row, Hampstead, N.W.
1898	Trans.		Bull, B. S., M.A., B.Sc., Ph.D., 26, Westcombe Rise, Humber-road, Blackheath, S.E.
1842			Bullock, Lloyd, 3, Hanover-street, Hanover-square, W.
1901			Bult, H. J., 18, Billiter-street, E.C.
1890			Bunting, H. H., c/o Peruvian Corporation, Lima, Peru
1896			Burbridge, J. K., Bush Lodge, Old Southgate, Middlesex
1891			Burford, Samuel Francis, The Firs, Kirby Muxloe, near Leicester
1898			Burge, C. H., Iddesleigh, Crescent-road, Kingston Hill, S.W.
1894	Proc.		Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.
1901			Burgess, P. J., M.A., Government Analyst, Singapore
1884			Burgess, William Thomas, F.I.C., 46, Portland-road, Holland Park, W.
1884			‖Burland, Jeffrey H., 824, Sherbrooke-street, Montreal
1897			Burland, R. O., J.P., Poolstock House, Wigan
1894			Burman, G. W., Laboratory, The Shelton Iron, Steel, and Coke Co., Limited, Stoke-on-Trent, Staffs.
1849	Trans.		Burnard, Charles F., Plymouth Chemical Works, & Chatsworth Lodge, Compton Gifford, Plymouth
1885	Trans.		Burnett, Joseph Fearon, 8, River View, Ashton, Preston
1901			‖Burnett, T. R., B.Sc., Ph.D., 34, Victoria-crescent, Dewsbury
1893			Burnham, John Charles, Cordite Factory, Wallington, Nilgiri Hills, India.
1882	Trans.		Burrell, B. Arthur, 5, Mount Preston, Leeds
1902	Trans.		Burrows, H., Ph.D., The Green, Southgate, N.
1901			Burrows, M. W., M.Sc., Dunkirk, Devizes
1900			Burton, William, Clifton Junction, near Manchester
1891			Burton, W., Victoria Cottage, Heaton-road, Canterbury
1882			Bush, Baron William de, Messrs. W. J. Bush and Co., Ash Grove, Hackney, N.E.
1894			Bush, William, The Retreat, Clytha Park, Newport, Mon.
1889			Butcher, W. F., c/o Messrs. W. Butcher & Sons, Mfg. Chemists, Blackheath, S.E.

Date of Election.		
1890		Butcher, William J., The Grammar School, Ashbourne, Derbyshire
1895		Butler, D. Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston, Birmingham
1894		Buttemer, Robt. Wm., St. Mary's, Godalming
1875		Butterfield, J. C., 79, Endlesham-road, Balham, S.W.
1892		Butterfield, W. J. Atkinson, M.A., Overdale, Bletchingley, Surrey
1892		Buttfield, Horace Vincent, 13, Wellington-road, Bush Hill Park, Enfield, N.
1888		Byrn, G. A., 97, Pitt-street, Sydney, N.S.W.
1893		‖Cahill, Robert S., Sunnyside, Heckmondwike.
1893		Çaines, C. M., 12, Carlton-gardens, Sheldon-road, Cricklewood, N.W.
1898	Proc.	Caldecott, W. A., B.A., Rand Club, Johannesburg
1891		‖Calder, William A. S., The Hollies, South-road, Smethwick, Birmingham
1884		Caley, Edward J., Chapel Field Works, Norwich
1896		Caley, John, Hull Oil Manufacturing Co., Stoneferry, Hull
1871		Calvert, J. H., Darwen Bank, Walton-le-Dale, Preston
1900		Calvert, S., M.A., B.Sc., State University, Columbia, Missouri, U.S.A.
1894		Cameron, Alex., Kronthal im Taunus, Germany
1897		Cameron, E. S., 17, Castle-street, Dublin
1875		Cameron, J. Macdonald, F.G.S., F.I.C., Castle Hill, Tain, N.B.
1893		Cameron, James, 36, Mersey-lane, Rock Ferry, Birkenhead
1897		Cameron, A. M., School of Mines, Castlemaine, Victoria
1892		Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burmah
1888		Campbell, J. Morrow, B.Sc., F.R.G.S., Blenheim-gardens, Wallington
1898		Campion, Alfred, Cooper's Hill, Englefield Green, Surrey
1896		Candy, Hugh, B.A., B.Sc., The College, London Hospital, E.
1884		Cannon, Matthew, 25, Stormont-road, Clapham Common, S.W.
1898		Cannon, M. J., 16 and 17, Devonshire-square, Bishopsgate, E.C.
1900		Cantin, A., Prof., Vacoas, Mauritius
1888		Carey, Alfred Edward, M.I.C.E., F.R.G.S., F.G.S., Dominion House, 110, Fenchurch-street, E.C.
1892	Trans.	Carey, Arthur, B.Sc., Browside, Gateacre, near Liverpool
1889		Carmody, P., Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.	Carpenter, H. C. H., B.A., Ph.D., Nat. Phys. Lab., Bushey House, Teddington, S.W.
1875		Carpenter, H. S., F.I.C., Beckington House, Weighton-road, Anerley, S.E.

Date of Election			
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895			Carr, Francis H., Kelvin, Church Avenue, Sidcup
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks
1898			Carroll, C. R., Hyderabad, Deccan, India
1882			||Carruthers, Robert, 90, High-street, Dumfries
1893			Carswell, Thomas Retson, 21, Avondale-square, Old Kent-road, S.E.
1864		C. 1878-81, 84-7	||Carteighe, Michael, 180, New Bond-street, W.
1901	Proc.		Carter, W., 7, Victoria-street, Clitheroe
1897			Cartmell, Alfred, Alexandra-road, Burton-on-Trent
1867			||Carulla, F. J. R., 84, Rose Hill-street, Derby
1895			Case, T. B., B.A., 82, St. James's-street, Dublin
1879			||Cassal, Major C. E., Town Hall, Kensington, W.
1902			Catchpole, F. E., 11, Jerningham-road, New Cross, S.E.
1894			Catherall, Ezra, Heathmere, Albany-road, Harborne, Birmingham
1898	Proc.		Caven, R. M., B.Sc., F.I.C., University College, Nottingham
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, A. G., Rugby
1894			Chambers, J. F., Arnolds, Nottingham
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			||Chance, Alexander M., Lawnside, Edgbaston
1872			||Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1872			Chandler, William H., Prof., Chem. Dept., Lehigh University, South Bethlehem, Penn., U.S.A.
1884			Chantrell, P. S., c/o Messrs. Tate & Sons, Ltd., Love-lane Sugar Refinery, Liverpool
1889			||Chaplin, Edward Mitchell, Ph.D., 60, Westgate, Wakefiled
1895			Chapman, A. J., 11, Baronsmere-road, East Finchley, N.
1886	Trans.		Chapman, Alfred C., F.I.C., 8, Duke-street, Aldgate, E.C.
1899	Trans.		Chapman, D. L., B.A., Hulme Hall, Plymouth Grove, Manchester
1900	Trans.		Chapman, E. M., 52, Newborough, Scarborough
1868			Chapman, Edward, Hill End, Mottram, Manchester
1884			Chapman, Herbert M., The War and Sporting Smokeless Powder Company, Tonbridge, Kent
1891			Charles, Rhys Pendrill, Plâs Newydd, Neath
1900			Chater, A. B., 65, Queen-street, Brisbane
1894	Trans.	C. 1900-	Chattaway, F. D., D.Sc., Ph.D., M.A., Longfield, Kenton-road, Harrow.
1895			Chattaway, William, Apothecaries' Hall, Blackfriars, E.C.
1895			Cheadle, Walter W., B.A., Chelmondiston, Ipswich

Date of Election.			
1899			Cheater, T. J., B.Sc., 6, Boutflower-road, Wandsworth Common, S.W.
1900			Cheeseright, J. W., 48, Balmoral-avenue, Gateshead
1890			Cheetham, T. A., Allan Glen's School, 68, North Hanover-street, Glasgow
1887			Chenhall, J. W., M.I.C.E., Dart-villas, Totnes, Devon
1878			Cheshire, H. F., Woodside, Shornden, St. Leonards
1882			‖Chester, Edward D.,
1897			Chikashigé, Masumi, B.Sc., Imperial University, Kyōtō, Japan
1871			Childs, Christopher, M.D., Oxon, 10, Manchester-square, W.
1897			Cholerton, A. F., Beech Leigh, Harboro'-road, Leicester
1891	Trans.		‖Chorley, John C., Lodge-lane, Bewsey, Warrington
1885			Christopher, G., Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William J., 7, West George-street, Glasgow ; and Shawfield Works, Rutherglen, near Glasgow
1856	Trans.	C. 1876-9, 87-9	Church, Arthur Herbert, F.R.S., Shelsey, Kew, Surrey
1888	Trans.		Claisen, Ludwig, Prof., Ph.D., Chemisches Institut, Brunswickerstrasse 2, Kiel
1901			Clark, Ernest, B.Sc., 9, Polygon-avenue, Stockport-road, Manchester
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1876	Trans.		Clark, John, Ph.D., 138, Bath-street, Glasgow
1897			Clarkson, Alexander, 2, Waveney-crescent, Ballymena, Ireland.
1852	Trans.		Claudet, Frederic, 6, Coleman-street, E.C.
1886			Clayden, Arthur W., M.A., F.G.S., St. John's, Polsloe-road, Exeter
1882	Proc.		Clayton, E. Godwin, F.I.C., 32, Holborn-viaduct, E.C.
1893			Clayton, George, School of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, Bentfield, Hunt's Cross, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, W., Sewage Outfall Works, Wolverhampton
1856			Clift, Samuel, 63, Dudley-road, West Bromwich
1878			Cloud, Thomas Charles, A.R.S.M., Walaroo Smelting Works, Walaroo, South Australia
1869	Trans.	C. 1885-9, 1899-	‖Clowes, Frank, Prof., D.Sc., 40, Craven-street, Strand, W.C.
1897			Clutterbuck, M. C., B.Sc., Ph.D., 61, Beaconsfield-villas, Brighton
1887			Coates, William Henry, M.A., M.B., L.S.Sc., M.R.C.S., L.R.C.P., L.S.A., 7, Albion-street, Hull

Date of Election.			
1896			Cobb, W. W., M.A., Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A., Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D., 115-119, W. 68th-street, New York, U.S.A.
1880			‖Cockburn, Arthur Cecil, Otley Grange, Otley, nr. Ipswich
1895	Trans.		Cockburn, G. B., B.A., B.Sc., Lingdale Lodge, Birkenhead
1901			Cockburn, T. R., 26, Elm-street, Whiteinch, Glasgow
1892			Cockerill, T., The Technical College, Colombo, Ceylon
1893			Cocking, Allan Thomas, The Grove, Stanford-le-Hope, Essex
1888			Cocking, Lewis Smith, Wharf Mills, Apsley, Huddersfield
1901			Coddington, E., B.A., 131, St. James's-road, Upper Tooting, S.W.
1881			‖Coffin, Walter H., 94, Cornwall-gardens, South Kensington, and Junior Athenæum Club, S.W.
1885	Trans.		Cohen, Julius B., Ph.D., Yorkshire College, Leeds
1901			‖Cohen, R. W., B.A., 11, Hyde Park-terrace, W.
1900			Cole, O. J., B.A., West Monmouthshire School, Pontypool, Mon.
1891	Trans.		Colefax, Arthur, Ph.D., M.A., 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Collenette, Adolphus, 11, Commercial-arcade, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcestershire
1881			Collett, John Marton, Guys Cliff, Wotton, Gloucester
1885	Trans.	{C. 1889-94, 1900-1}	‖Collie, J. Norman, Ph.D., F.R.S., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc., Warwick Lodge, Hadley, Barnet
1892			‖Collins, Hugh Brown, B.Sc., Auchinbothel, Kilmalcolm, N.B.
1890			Collins, Sydney Hoare, Durham College of Science, Newcastle-on-Tyne
1888			Collins, W. Hepworth, c/o Messrs. Wild and Co., 17, Nicolas-street, Manchester
1887	Trans.		‖Colman, Harold G., Ph.D., 23, Stirling-road, Edgbaston, Birmingham
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900			Comber, A. W., 48, Park-road, Southend
1892			‖Comyns, Frank, M.A., The Lindens, Newbury, Berks
1891			Congdon, Prof. Ernest A., The Drexel Institute of Art, Science, and Industry, Chestnut-street, Philadelphia, Penn., U.S.A.
1899			Connah, James, B.Sc., F.I.C., Geralton, Carlton-road, Sidcup
1899			Connell, R. D., Rio Marina, Isola, d'Elba, Italy
1875			Connor, Charles C., B.A.,
1883			‖Conrad, Edwin C., Manor House, Chalk, Gravesend
1875	Trans.		‖Cook, E. H., D.Sc. (Lond.), the Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol

Date of Election.		
1895		Cook, Herbert W., B.Sc., Dunraven, Park-road, Tunbridge Wells
1890		Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888		Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889		Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.
1897		‖Cooper, A. J. Bullen, Grimston Lawn, Ealing, W.
1892		Cooper, Arthur James, Brewood School, Staffordshire
1888		Cooper, Astley, Oatlands Chemical Works, Meanwood-road, Leeds
1898		Cooper, John, 31, Lily-avenue, Jesmond, Newcastle-on-Tyne
1900		Cooper, W. F., B.A., 6, Hobson-street, Cambridge
1891		Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897		Cooper, W. R., M.A., 87, Upper Tulse-hill, S.W.
1894	Proc.	Coote, A. H., 1, Mycene-road, Blackheath, S.E.
1899		Cope, Frank, 92, Bradford-road, Dewsbury
1890		Coppock, J. B., Science School, Lansdown, Stroud
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts
1866		‖Corfield, W. H., M.A., M.D. (Oxon), F.G.S., Professor of Hygiene and Public Health, University College, W.C., and 19, Saville-row, W.
1901		Cormack, W., 3, Westfield-place, Eskbank, N.B.
1888		‖Cornish, Vaughan, D.Sc., 72, Princes-square, W.
1890		Corrie, David, Nobel's Explosives Company, West Quarter Factory, Polmont Station, N.B.
1891		Cory, G. E., M.A., St. Andrew's College, Grahamstown, S.A.
1893	Trans.	Coste, John Henry, 206, Amhurst-road, Hackney, N.E.
1892		‖Couldrey, Henry, H.M.'s Mint, Bombay, India
1900		Courtman, E. O., Derford-house, Atkins-road, Clapham-park, S.W.
1901		Cousins, H. H., M.A., Government Laboratory, Kingston, Jamaica
1885		Cousins, William J., 17, Temple-chambers, Temple-avenue, E.C.
1886	Trans.	‖Coutts, Francis J. H., M.D., D.P.H. (Vict.), 22, Read's-avenue, Blackpool
1898		Cowburn, A. W., Fernroyd, Bowdon, Cheshire
1882		‖Cowie, Thomas R., Merchant-street, Rangoon, Burmah
1898		Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873		Cownley, Alfred J., 13, Fenchurch-avenue, E.C.
1888		Cowper, Joseph, 50, King-street, Penrith
1886		Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898		Cox, F. Hudson, 46, St. James'-road, Brixton, S.W.
1873		Cox, Samuel Herbert, 13, St. Helen's-place, London, E.C.
1901		Crabtreee, A., 9, Bigg Market, Newcastle-on-Tyne
1870		Crafts, Prof. J. M., 59, Marlborough-street, Boston, Mass., U.S.A.
1892	Trans.	Craig, Andrew William, College of Pharmacy, Swanston-street, North Melbourne, Victoria

Date of Election.			
1875			‖Crampton, George,
1897			Cranfield, William, 5, Second-avenue, Halifax
1893			Craw, John A., 58, S. Dundas-street, Glasgow
1897			Creasey, C. H., 6, Park-terrace, Llandaff Fields, Cardiff
1875			Cresswell, Charles Gerard, Ermyngarth, Ashtead
1887			Cribb, Cecil H., B.Sc., 136, Shaftesbury-avenue, W.
1878			Criper, William Risdon, Chemical Works, Konnagar, Calcutta
1895			Crocker, C., St. Peter's-road, Cockett, Swansea
1901			Crocker, W. G., 39, Arnold-street, Liverpool
1897	Trans.		Crofts, J. Murray, M.A., B.Sc., Richleigh, Gloucester
1886	Trans.		‖Crompton, Holland, Glynn-cottage, Chester-road, Northwood, Middlesex
1901			Crookes, S. I., Clay Cross, near Chesterfield
1857	Trans.	C.1865-9 V.P. 76-8, 85-6 P. 87-9	‖Crookes, Sir William, F.R.S., 7, Kensington Park-gardens, W. and Athenæum Club, Pall Mall, S.W.
1879	Trans.	C.1890-1 93-5	Cross, Charles Frederick, 4, New-court, Lincoln's-inn, W.C.
1890	Trans.	C. 1901-2	‖Crossley, Arthur W., D.Sc. (Vict.), Ph.D., Chemical Laboratory, St. Thomas's Hospital, S.E.
1901			Crossley, F., Duchy Bank, Seedley-road, Pendleton, Manchester
1896			Crossman, C. M., B.Sc., South-lodge, Edgware, Middlesex
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1899			Crouch, W. S., Hersham, Walton-on-Thames
1880	Trans.		Crow, John Kent, D.Sc., Tressillian, Ulundi-road, Blackheath, S.E.
1887			‖Crowther, H. Woodward, The Beeches, West Bromwich
1895			Croysdale, John, Whitley Bridge, R.S.O., Yorkshire
1884			Crumbie, William D., 146, Washington-street, East Orange, New Jersey, U.S.A.
1900			Cullinan, N., M.D., L.R.C.P., Pontymister, Newport
1887	Trans.		Cundall, J. Tudor, B.Sc., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1899			Cunnington, A. V., c/o Brunner, Mond & Co., Northwich
1875			Curphey, W. S., Borva, Lenzie, N.B.
1900			Cussons, John, B.Sc., Grammar School, Witney, Oxon
1881			‖Custance, John D., Prof., Park-road, Cowes, Isle of Wight
1895			Cuthbertson, L. M. G., 89, Lordship-park, N.
1894			Dains, Herbert H., F.I.C., 3, Cantonment, Vizianagram, India
1901	Trans.		Dakin, H. D., 9, Beech-grove-terrace, Leeds
1901			Daniel, G. H., B.Sc., 21, Church-walk, Ulverston
1897			Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal
1887			Daniell, L. C., Royal Standard Brewery, Tamworth, N.S.W.
1902			Daniels, J., Westwood, Medomsley R.S.O., Durham

Date of Election.		
1850		‖Danson, Joseph,
1899		Danziger, H. M., Laurel Bank, Higher Broughton, Manchester
1892		Darbishire, Francis V., B.A., Ph.D., Hulme Hall, Plymouth-grove, Manchester
1852		Darby, Stephen, Cookham Dean, Berks
1899		Darling, C. R., 12, Nithdale-road, Plumstead, S.E.
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	Darling, William Howarth, 126, Oxford-street, Manchester
1875		‖Davey, G. W., Bleak House, Barking Creek, Essex
1893		Davey, George, 219, Ladbroke-grove, Notting Hill, W.
1897		Davidge, H. N., 1, Rydal-gardens, Rydal-road, Streatham, S.W.
1900		Davidson, A., 2, Hamilton-park-terrace, Hillhead, Glasgow
1901		Davidson, J. H., B.Sc., Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell Green, Halifax
1899		Davidson, W. B., M.A., B.Sc., Ph.D., Chemical Dept., University, Aberdeen
1866	Trans.	‖Davies, Arthur E., Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, The Laboratory, 28, Chapel-street, Liverpool
1894		Davies, L. J., Bute Chambers, Bute-road, Cardiff
1896		Davies, S. H., Rowntree's Cocoa Works, York
1900		Davis, A. C., 2, Downing-grove, Cambridge
1901		Davis, Francis Whitwell, Ellam, Yorks
1902		Davis, Frederick, B.Sc., 29, Bridgmont, Whalley Bridge, near Stockport
1857		‖Davis, J. Frederick, F.G.S., Archbrook, Budleigh-Salterton, Devon
1872	Trans	‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876		Davis, T. Sebastian, 199, South Lambeth-road, S.W.
1897	Trans.	Davis, W. A., Central Technical College, South Kensington, S.W.
1876		‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1900		Davison, S. C., 49, Victoria-road, New Swindon, Wilts.
1895		Daw, F. W., Eureka-place, Ebbw Vale, Monmouthshire
1900	Trans.	Dawson, H. M., B.Sc., Ph.D., The Yorkshire College, and North-terrace, Bramley, Leeds
1899		Dawson, H. Royal, Bentleys Yorkshire Breweries, Woodlesford, near Leeds
1890		Day, Charles Edwin, B.Sc., Sussex-house, Rowlands-road, Worthing
1881	Trans.	‖Day, T. Cuthbert, 36, Hillside-crescent, Edinburgh
1901	Trans.	Dean, G., M.A., The Firlands, Redcar, Yorks.
1886		Deane, Leopold M., Davington-house, and The Cotton Powder Co., Ltd., Faversham

Date of Election.			
1859	Trans.	V.P. 1871-3	Debus, Heinrich, Prof., Ph.D., F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1899			‖De Castro, J. P., B.A., Ford House, Redruth, Cornwall
1885	Trans.		Dechan, Martin, Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, 9, King's-parade, Cambridge
1869	Trans.		‖Deering, W. H., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël F., Plantation Albion, Demerara, B.G.
1901			De la Rue, E. A., B.A., 52, Cadogan-square, S.W.
1881			Demarçay, Eugene Anatole, 80, Bd. Malesherbes, Paris
1892			Denison, Joseph R., 4, Duckworth-grove, Manningham, Bradford
1890			Dennant, John, F.G.S., Orwell, Stanhope-grove, Camberwell, Victoria
1902			Dennis, W., Ocean-road Pharmacy, South Shields
1897			Deverell, L. C., Laboratory, 104 Upper Thames-street
1870	Trans.	C. 1874-6 V.P. 80-2 86-8, 96-7 P. 97-9	‖Dewar, James, Prof., M.A., LL.D., F.R.S., Royal Institution, Albemarle-street, W.
1900			Dewhirst, J. A., 36, Southfield-square, Bradford
1886			‖Dey, Preo Lall, 4, Beadon-street, Calcutta
1897			Diamond, William, Barron Collieries, near Barnsley
1880			Dibdin, W. J., F.I.C., Mayfield, Grange-road, Sutton, Surrey
1872			Dickenson, Arthur John, F.I.C., 4, Shardeloes-road, New Cross, S.E.
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1887			Dickson, T. Arthur, Estate Office, Overstone Park, Northampton
1860	Trans.	C. 1873-4 V.P. 1900-	‖Divers, Edward, Prof., M.D., F.R.S., 9, Rugby-mansions, Addison Bridge, Kensington
1897			Dixon, A. J., Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900-	Dixon, Augustus Edward, Prof., M.D., Queen's College, Cork
1896	Trans.		Dixon, Frank, B.Sc., The Foundation School, Whitechapel-road, E.
1894	Proc.		‖Dixon, George, M.A., Trinity College, Cambridge and St. Bees, R.S.O., Cumberland
1876	Trans.	1892-6 C.	Dixon, Harold B., Prof., F.R.S., Owens College, Manchester
1893			Dixon, Harry W., Clarence Iron and Steel Works, Leeds
1901			Dixon, J. K S., Gothic House, Birkstall, nr. Leeds
1895			Dixon, W., 102, Spring-street, Bury
1862			Dixon, W. A., 97, Pitt-street, Sydney, N.S.W.
1890			Dixon, William, 4, Park-place East, Sunderland
1882	Trans.		Dobbie, James Johnstone, Prof., M.A., D.Sc., University College, Bangor, N. Wales
1887	Trans.		Dobbin, Leonard, Ph.D., Chemical Laboratory, New University-buildings, Edinburgh
1898			Dodd, F. R., Victoria-terrace, Southport-road, Ormskirk
1901			Dodd, R., 28, Sibella-road, Clapham, S.W.

Date of Election		
1875	Trans.	‖Dodd, T.H., Chemical Department, Royal Arsenal, Woolwich, S.E
1888		‖Dodd, William Henry, 8, Kempson-road, Walham-green, S.W.
1886		Dodd, W. Ralph, Oakdene, Bush-hill Park, Enfield, N.
1892		Dodds, George Price, 40, Greenbank-road, Darlington
1897		Dodgson, J. W., B.Sc., Eversley, Llewellyn-street, Aberdare, S. Wales
1894	Proc.	Doherty, W. M., Government Laboratory, Sydney, N.S.W.
1898		Don, J. R., M.A., D.Sc., Waitaki High School, Oamaru, N.Z.
1900		Donald, W., Saltcoats, Ayr
1892		Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1901		Donnan, F. G., M.A., Ph.D., Chemical Laboratory, University College, W.C.
1897	Trans.	Dootson, F. W., M.A., Ph.D., University Chemical Laboratory, Cambridge
1886	Trans.	Doran, Robert Elliott, Chemical Dept. Queen's College, Cork
1902		Dorée, C., M.A., 87, Gore-road, N.E.
1886		Dormer, Richard, Garston
1900		Dougall, J. D., Senhouse-street, Maryport, Cumberland
1888		Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1884		Down, Frederick J., Glengariff, Milton-road, Harpenden, Herts.
1887		Downes, Arthur H., M.D., Local Gov. Board, Whitehall, S.W.
1898	Trans.	Dowzard, Edwin, 78, Rawson-road, Seaforth, Liverpool
1899		Doyle, Frederick, 64 Palmerston-terrace, Middlesbrough
1899		Drake, F. A., B.Sc., 24, Cavendish-square, Hull
1884		Draper, Henry Carter, 25, Earlsfort-terrace, Dublin
1891		Dreaper, W. Porter, Clifton Villa, Coggeshall-road, Braintree, Essex
1893		Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1895		Druce, Edric, Agricultural College, Holmes Chapel, Cheshire
1901		Dubois, R., B.Sc., Viticultural College, Rutherglen, Victoria
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1901		Duckworth, W. H., Municipal Technical School, Blackburn
1900		Dudderidge, F. R., 45, Sydney-grove, Newcastle-on-Tyne
1898		Dudley, C. B., Ph.D., Drawer 334, Attoona, Penn., U.S.A.
1890		‖Dudley, William L., Prof. Vanderbilt Univ., Nashville, Tennessee, U.S.A.
1892		Duffield, Walter William, 5, Ashington-road, Parson's-green, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A., D.Sc., Holmesdale, The Avenue, Cambridge
1897		Dufty, Lawrence, 23, Broomhall-place, Sheffield
1884		Duggan, T. R., Sunny-bank, Vanburgh-hill, Westcombe-park, Blackheath, S.E.
1889		Duisberg, Dr. Carl, Elberfeld, Germany

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889			Dukes, Thomas William, P. T. Peterson and Co., P.O. Box 210, Johannesberg, S.A.R.
881			Duncan, Arthur W., 42, Trevelyan-street, Eccles, Manchester
894	Proc.		‖Duncan, C. C., The Shire Hall, Worcester
863			Duncan, James, 9, Mincing-Lane, E.C.
894			Duncan, Dr. John,
891			Duncan, William, The Laboratory, 65, Bath-row, Edgbaston, Birmingham
896			Duncan, William, Royal Dispensary, 21, W. Richmond-street, Edinburgh
894	Proc.		‖Dunn, Frederic, 193, Collins-street, Melbourne
888			Dunn, John, B.Sc., Morgan Academy, Dundee
882			Dunn, J. T., D.Sc., 75, Side, Newcastle-on-Tyne
893			Dunnington, Francis P., University of Virginia, Charlottesville, U.S.A.
899			Dunscombe, F. C., c/o Electric Reduction Co., Buckingham, Quebec
901			Dunstan, A. E., B.Sc., Owens School, Islington, N.
879	Trans.	C. 1888-91 S. 93-	‖Dunstan, Wyndham R., Prof., M.A., F.R.S., Scientific Department, Imperial Institute, S.W.
860	Trans.	C. 1871-4	Dupré, August, Ph.D., F.R.S., 2, Edinburgh Mansions, Howick Place, S.W.
896			Durant, H. T., c/o Messrs. Butters & Co., Dooly Bdg., Salt Lake City, Utah, U.S.A.
871			‖Durham, Henry, City of London School, Victoria Embankment, E.C.
883	Proc.		Durrant, Reginald G., M.A., The College, Marlborough, Wilts.
892			Duxbury, Thomas, 17, Grosvenor-chas., Deansgate, Manchester
875	Trans.	C. 1893-7	‖Dyer, Bernard, D.Sc. (Lond.), 17, Great Tower-street, E.C.
890	Trans.		Dymond, Thomas Southall, 78, Duke-street, Chelmsford
885	Trans.		Dyson, Gibson, Ph.D., Hatfield Court, Leominster
883	Trans.		‖Dyson, Septimus, 8, Belmont-avenue, Harrogate
900			Eadie, R., Colombo Commercial Co., Ltd., Slave Island, Colombo
876			‖Earp, Francis S., Ph.D., F.I.C., Boulder Porseverance Gold Mining Co., Boulder City, W.A.
889	Trans.		Easterfield, Thomas Hill, Prof., M.A., Ph.D., The Victoria College, Wellington, New Zealand.
891			Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
881			Eastick, John J., Millaquin Refinery, Bundaberg, Queensland
878	Trans.		‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire

Date of Election.		
1881		Edgell, R. Arnold, Rev., M.A., The College House, Leamington
1876		Edmunds, James, M.D., 4, Chichester-terr., Kemp Town, Brighton
1893		Edwards, Thomas, Brewery House, Rhymney, viâ Cardiff
1884		Edwards, Vincent, Lawes' Chemical Manure Co., Barking Creek, Essex
1892		Edwards, Walter N., 4, Herne Hill-road, Camberwell, S.E.
1898		||Edwards, W. T. A., Experiment Station, Reduit, Mauritius
1887		||Ehrhardt, Ernest Francis, D.Sc., Ph.D., A.M.C. Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany
1884		Ehrmann, Leon, c/o Messrs. Packard & Co., Ltd., Ipswich
1899		Eichenauer, W. F., 64, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, 143, New Bond-street, W.
1883		||Ekins, Arthur E., Worley House, St. Albans
1887		Elborne, William, M.A. (Cantab.), School of Science and Art, Peterborough
1891		Elford, Percy, St. John's College, Oxford
1901		Eling, T. H. J., 32, Hill Top-avenue, Shepherds-lane, Leeds
1878		||Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, W. J., M.A., The Grammar School, Leeds
1893		Ellis, C. Sordes, F.I.C., Smokeless Powder and Ammunition Co., Ltd., Barwick, near Ware, Herts.
1900		Ellis, F. R., 15, Shadwell-road, Bishopston, Bristol
1901		Ellis, H. E , Victoria House, Llanfair, near Welshpool
1878		Ellis, W. H., School of Practical Science, Toronto, Ontario, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1888		Ellwood, Thomas Ashcroft, 111, Stroud Green-road, N.
1893		Elmore, Alexander Stanley, 239, Willesden-lane, N.W.
1902		Elsden, A. V., 44, Shaftesbury-road, Ravenscourt-park, W.
1886	Trans.	Elworthy, Herbert Samuel, 239, Dashwood House, New Broad-street, E.C.
1885		Embrey, George, County Laboratory, Brunswick-road, Gloucester
1887		||Emmons, Hamilton,
1901		English, R., Crystal Palace District Gas Co., Engineer's Office, Lower Sydenham, S.E.
1892		Entwistle, Herbert, 1, Albert-place, Dickenson-road, Longsight, Manchester
1899		Epps, J. W., 95, Upper Tulse Hill, S.W.
1885		Epps, James, junr., Norfolk House, Beulah Hill, Upper Norwood, S.E.
1889		Erskine, J. Kerr, New Kleinfontein Co. (per Private bag), Johannesberg, S.A.R.
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport

Date of Election.		
1862		‖Esson, William, Prof., F.R.S., Merton College, Oxford
1865		‖Estcourt, Charles, Seymour-house, Seymour-grove, Old Trafford, Manchester
1899		Estcourt, H. E., Seymour-house, Old Trafford, Manchester
1888		‖Estcourt, Philip Anderson, Seymour House, Seymour-grove, Old Trafford, Manchester
1894		Eumorfopoulos, Nicholas, B.Sc., 33, Gloucester-square, Hyde Park, W.
1895		Eutroppe, A. T., Fort Baker, California, U.S.A.
1891		Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope
1893		Evans, Gwilym, 7, Stepney-street, Llanelly, South Wales
1876		Evans, Sir John, K.C.B., D.C.L., LL.D., F.R.S., Nash Mills, Hemel Hempstead
1892	Trans.	‖Evans, Robert Cecil Turle, 9, Heathcote-street, Grays Inn-road, W.C.
1888		‖Everard, Arthur George, Normanhurst, 115, Broomwood-road, Wandsworth Common, S.W.
1894		Evershed, Frank, Kenley, Surrey
1896	Trans.	Ewan, Thomas, M.Sc., Ph.D., c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1902		Eynon, L., 57, Darenth-road, Stamford-hill, N.
1901	Trans.	Eyre, J. V., 26, Bridge-road West, Battersea-park, S.W.
1888		Faber, Harald N., 7 and 8, Idol-lane, E.C.
1865	Trans.	‖Fairley, Thomas, F.R.S.E., 17, East-parade, Leeds
1895		Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899		Fairweather, E. B., King's College Hospital, Lincoln's Inn Fields, W.C.
1888		Farlie, John B., 54, Wellington-road, Old Charlton, Kent, S.E.
1895		Farr, E. H., Uckfield, Sussex
1870		‖Farries, Thomas, 16, Coleman-street, E.C.
1880		‖Farrington, T., M.A., 5, Summerhill-terrace, Wellington, Cork
1902		Fasnacht, E. A., Clayton Mount, Newton Heath, Manchester.
1895		Fauvel, C. J., c/o Messrs. Stobb & Roscoe, 76, Bishopsgate-street, E.C.
1894		Fawcett, Joseph Addey,
1887		Fawsitt, Charles A., 9, Foremount-terrace, Dowanhill, Glasgow
1888		Featherstone, W. B., 13, Temple-street, Birmingham
1900		Fechtner, A. L. W., 2, Queen-street, Withernsea
1888		Fell, John Campbell, 112, Pembroke-street, N.
1897		Fenby, A. V. C., B.Sc., Hinton House, Huddersfield-road, Birstall, Leeds

Date of Election.			
1878	Trans.	C. 1898-1902	‖Fenton, H. J. H., M.A., F.R.S., Christ College, Cambridge, and 7, Mortimer-road, Cambridge
1872		C. 1889-93	‖Ferguson, John, Prof., M.A., University of Glasgow
1898			Ferguson, J. E., 4, Waltersville-road, Crouch-Hill, N.
1901			Ferguson, R. W., 125, Church-street, Edgware-road, W.
1899			Fermor, H. F. F. B., 15, Ansdell-road, Peckham, S.E.
1901			Ferrand, F., 13, Torrington-street, Hopwood, Heywood
1864			‖Ferreira, A. A., M.P.S.
1889			Ferrier, David, 1, Edin-terrace, Perth
1882			Ferrier, James, Columbus, Georgia, U.S.A.
1895			Fielding, P. J. D., 8, St. Joseph's-place, Cork
1900	Trans.		Findlay, Alexander, M.A., Ph.D., B.Sc., Chem. Dept., University College, W.C.
1890			Findlay, George H., Burmantofts Brewery, Leeds
1896			Fisher, E. H., The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Frederick William, M.A., 64, Pont-street, S.W.
1900			FitzGibbon, Thos., 1, Clyde Cottage, Ilford
1896			Fleet, J. T., 24, Sheep-street, Rugby
1899			Fleischmann, F. N. A., 6, Collingham-gardens, South Kensington, S.W.
1898			‖Fleming, J. A., Britannia Pottery, 136, Glebe-street, Glasgow
1874			Fletcher, Frederick W., North London Chemical Works, Holloway, N., and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A., F.R.S., Natural History Department, British Museum, Cromwell-road, S.W.
1872	Trans.		‖Fletcher, Thomas William, Grappenhall, *via* Warrington
1894			‖Flintoff, Robert J., 17, Todmorden-road, Littleborough, Manchester
1892			Floris, Robert Brooke, Church-house, West Hanningfield, near Chelmsford
1894			Fogg, C. A., 39, Park-road, Bolton
1859			Fogg, Thomas, 6, Clarendon-gardens, Maida-vale, W.
1889			Foggie, John, University College, Dundee
1885			Follows, Harold, Victoria Villas, Humphrey-lane, Urmston, near Manchester
1894			‖Forbes, D. G., The Post Office, Kalgoorlie, West Australia
1874			Forbes, James, jun., 70, Gracechurch-street, E.C.
1889			Ford, John S., care of Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton
1893			Forrester, Alexander M., Laboratory, Port Dundas Chemical Works, 20, Canal Bank, Glasgow

Date of Election.			
1892	Trans.	C. 1901-	‖Forster, Martin Onslow, Ph.D., Royal College of Science, South Kensington, S.W.
1856	Trans.	C. 1865-8, 72-4, 85-6 V.P. 88-92	‖Foster, Prof. G. Carey, F.R.S., Ladywalk, Rickmansworth, Herts
1895			Foster, H. Irving, 2, Beech-grove, Newland, Beverley-road, Hull
1872			Foster, Reginald Le Neve, Harrytown Hall, Bredbury, near Stockport
1900			Foulds, Jas., Jesmond-house, Dymond-road, Heckmondwike.
1898			Foulerton, A. G. R., F.R.C.S., Dunsdale, Mulgrave-road, Sutton, Surrey
1891	Trans.		‖Fowler, Gilbert J., M.Sc., Broad Oak, Urmston, Manchester
1900			Fowler, M.B., 13, Cavendish-road, Westbury-on-Trim, near Bristol
1882			‖Fowler, William, M.Sc., 1, Grace-terrace, Sunderland
1895			Fox, A. Stanley, 23, South-road, Faversham
1884			‖Foye, Martin Hugh, M.B., C.M.,
1879			Francis, Edward, Ivy Bank, Park Ravine, Nottingham
1873			‖Francis, G. Bult, 38, Southwark-street, S.E.
1842	Trans.	C. 1860-2	Francis, William, Ph.D., F.L.S., Manor-house, Richmond, Surrey, and Red Lion-court, Fleet-street, E.C.
1881			Frankland, Henry, Streonshalk, The Crescent, Linthorpe, Middlesbro'
1880	Trans.	C. 1887-8 V.P. 1902	‖Frankland, Percy Faraday, Prof., Ph.D., LL.D., F.R.S., The University, Birmingham
1867			‖Fraser, Angus, M.D., 232, Union-street, Aberdeen
1892			‖Fraser, James C., Mercantile-chas., Victoria-square, Adelaide, S.A.
1885			Freear, Harry M., Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick W., 7, Park Hall-place, East Finchley, N.E.
1900			Freeman, W. L., B.A., 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph T., Fenestella, Egerton-park, Rock Ferry, Cheshire
1892	Proc.		French, William, Storey Institute, Lancaster
1889	Trans.		Frew, William, Ph.D. (Mun.), Well Park Brewery, Glasgow
1871	Trans.	C. 1884-8, 92-6	‖Friswell, R. J., Bound-road, Higham, Kent
1890			‖Frost, Robert, B.Sc., 53, Victoria-road, Kensington, W.
1899			Fry, G. C., B.Sc., Myrtle Cottage, Saltaire, Yorks.
1899	Trans.		Frye, C. C., Burwood, Woodville-road, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A., Ph.D., F.I.C., 13, Eaton-crescent, Clifton, Bristol
1895			Fuerst, A. F., Ph.D., 30, Wood-street, E.C.
1891			Fulcher, Lionel William, B.Sc., Victoria and Albert Museum, S.W., and 56, Buckleigh-road, Streatham Common, S.W.
1896			Fuller, C. J. P., 79, Brownlow-road, Horwich, Lancs.

Date of Election.		
1886		Fuller, John, Rookwood, Montpelier-road, Ealing, W.
1883		Fulton, H. B., 353, Mansion House Chambers, 11, Queen Victoria-street, E.C.
1894		Gabb, George Hugh, 43, Charlotte-street, Fitzroy-square, W.
1899		Gabriel, E. V., Ajmere, Rajputana, India
1901		Gadd, H. W., 42, Union-road, Exeter
1866		Gale, James, M.A., Ph.D., F.G.S., 124, Adelaide-road, South Hampstead, N.W.
1851		‖Gamble, Sir David, Bart., C.B., Windlehurst, St. Helens, Lancashire
1876		Gamble, J. C., Haresfinch, St. Helens, Lancashire
1883	Proc.	‖Garbutt, Llewellyn, M.A., 10, College-street, Winchester
1888		Gardiner, James H., 59, Wroughton-road, Balham, S.W.
1901		Gardner, H. C. T., London Hospital, E.
1898		Gardner, James E., 413, Park-road, Oldham
1893	Trans.	Gardner, J. Addyman, M.A., Chemical Department, St. George's Hospital, S.W.
1888		Gardner, Walter M., Technical College, and Willow Cottage, Cross-lane, Gt. Horton, Bradford
1893	Trans.	Garnett, Henry, 49, Market-square, Witney, Oxon.
1889	Proc.	Garrett, Frederic Chas., M.Sc., Durham College of Science, Newcastle
1880		Garrod, A. E., M.D., 9 Chandos Street, Cavendish-square, W.
1898		Garside, A. L. H., B.Sc., c/o Dr. Miller, Kilvert's-buildings, Withygrove, Manchester
1884		Gaskell, Joseph, 71, Haworth-buildings, Cross-street, Manchester
1900		Gasson, W., Dutoitspan-road, Kimberley, S.A.
1847		Gatty, F. A., Bannister Hall Works, near Preston, Lancashire
1875		Gee, T. Ernest, F.R.C.P., 67, Westbourne-park-road, W.
1887		Geisler, Joseph F., Ph.C., Mercantile Exchange Buildings, Hudson and Harrison-streets, New York
1900	Trans.	Geldard, Julius, 120, Park Field-terrace, Otley Road, Bradford
1885		Gemmell, George Harrison, 4, Lindsay-place, Edinburgh
1879		Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Longton High School, Longton, Staffs.
1889		‖Gerland, Conrad, M.Sc., Ph.D., Meadow Bank, Accrington
1891		German, George, jun., Huntingdon House, Ashby-de-la-Zouch
1895		‖Gerrans, H. Tresawna, M.A., 20, St. John Street, Oxford
1875		Gerrard, A. W., 35, Queen's-road, Wimbledon, S.W.
1899		Getman, F. H., John Hopkins University, Baltimore, Maryland, U.S.A.
1888		Geyzel, John Lawrence Van, Surgeon-Major, Chemical Examiner, Medical College, Madras, East India

Date of Election.			
1890			‖Gibbes, Cuthbert C., M.D., M.C., L.R.C.P., D.P.H., 89 Harley-street, W.
1900			Gibbings, G. W., Assay Department, Standard Bank, Salisbury, Mashonaland
1897			Gibbons, J. L., The Higher Grade School, Blyth, Northumberland
1885			Gibson, Adam, c/o Messrs. Pinkerton, Gibson & Co., Thistle-street-lane East, Edinburgh
1900			Gibson, John, Battle Hill, Hexham
1892	Trans.		Gibson, John, Ph.D., F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1888			Gibson, W. Humphrey, 122, King's-road, Brighton
1898			Gidden, W. T., The Hawthorns, Moat-road, Warley, near Birmingham
1897	Trans.		Gilbody, A. W., M.Sc., Ph.D., Mun. Tech. College, Bradford
1898			Gilderdale, Frederick, 3, Havelock-street, Newcastle-on-Tyne
1883			‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants
1881			Gill, E. I. G., Branceni, Gara, Tigaresci, Roumania
1888			Gill, John, Gwealhellis, Helston, Cornwall
1898	Proc.		Gilles, W. S., Bradford-street, Bocking, Braintree, Essex
1865			‖Gillman, A. W.,
1901			Gillman, E., Government Lab., Barbados, West Indies
1885			Girdwood, Gilbert P., M.D., 111, University-street, Montreal
1897			Girtin, Thomas, B.A., 125A, Highbury New Park, N.
1848	Trans.	C. 1852-5, 61-2 V.P 1867-9, 74-6 P. 1877 9	Gladstone, John Hall, Ph.D., F.R.S., 17, Pembridge-square, Hyde Park, W.
1898			Glaister, John, Prof., M.D., 18, Woodside-place, Glasgow
1872			‖Glover, George Thomas, Corbys, Hoylake, Cheshire
1895			Goldfinch, George, Hendon, N.W.
1899			Golding, John, Midland Agric. and Dairy Inst., Kingston, Derby
1878			‖Goldschmidt, S. A., Ph.D., care of Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, New York, U.S.A.
1889			Goldsmith, Byron B., 19, East 74th-street, New York City U.S.A.
1898			Goldsmith, J. N., B.Sc., Ph.D., British Xylonite Co., Manningtree, Essex.
1896			Goldstand, L. F., Nowo-Zielna 48, Warsaw, Russian Poland
1899			Goltz, H. F. C., 155, Minton Hill, S.W.
1897			Gomess, A. F. Bilderbeck, M.R.C.S., 33, Drayton-gardens, South Kensington, S.W.
1900			Gompertz, R. H. C., 47, Dulwich-road, Herne Hill, S.W.
1892			Goodall, Walter, Alma House, Pudsey, near Leeds
1890			Goodwin, Thomas S., Prof. Veterinary College, Buccleuch-street, Glasgow

Date of Election.			
1896			Goodwin, William, Queen's College, Galway, and Thorncliffe, Macclesfield
1890			Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1887	Proc.		Gordon, Hugh, M.A. Oxon, Eastmount, Darlington.
1875			Gordon, J. G., Queen Anne's Mansions, Westminster, S.W.
1890			Gossling, Frank, B.Sc., H.M. Patent Office, Staple Inn, W.C.
1889	Trans.		‖Gott, B. S., M.A., The Guildhall, Westminster, S.W.
1897			Gough, H. W., B.A., 58, Billing-road, Northampton
1900			Gough, J. H., 14, Francis-street, Chapeltown-road, Leeds
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, 98, Stroud Green-road, N.
1887			Gover, Herbert J., 29, Piccadilly, Hanley, Staffordshire
1889			Gow, Robert J., Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, 18, West View-road, Barrow-in-Furness
1871	Trans.	C. 1898-1901.	‖Gowland, William, 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George A., Hawkins-road, Medindie, Adelaide, South Australia
1884			Grace, W. F., 54, York-road, Hove, Brighton
1894			Grafton, Walter, 102, Byron-avenue East, East Ham, Essex
1880	Trans.		‖Graham, C. Colborne, Highmoor, Benrhydding-road, Ilkley, Yorks.
1862		C. 1880-1	‖Graham, Charles, D.Sc., The Reculvers, Hastings
1895	Trans.		Graham, Edward, B.Sc., Highcroft, Tilehurst, Berks
1890			Grant, James, F.I.C., 9, Arthur-street, Prestwich, near Manchester
1895	Trans.		Grant, P. Hope, 94, Copleston-road, Denmark-hill, S.E.
1887			Gravill, Edward D., F.R.M.S., 42, Walmsley-street, Hull
1882			Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900			Gray, R. W., 7, Orme-court, Bayswater, W.
1892	Trans.		Gray, Thomas, B.Sc., Ph.D., 204, George-street, Glasgow
1895			Greaves, W. A., 20, Beacon Hill-road, Newark
1890			Green, Alfred H., Oaklands, Lowton St Mary's, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, 1, Dartmouth-road, Brondesbury, N.W.
1893			Green, Arthur Henry, 12, Cawdor-road, Fallowfield, Manchester
1902			Green, C. J., B.Sc., 24, Dalburg-road, Brixton, S.W.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, F.I.C., A.R.S.M., 93, Talbot-street, Southport
1878			Green, Lawrence, Lower Tovil, Maidstone
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey
1885			Greenway, Thomas J., 2nd Avenue, St. Peter's, South Australia

Date of Election.			
1873			Greenwood, William Henry, Birmingham Metal and Munitions Co., Ltd., Adderley Park Works, Birmingham
1894	Proc.		Greeves, A., 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D., B.Sc., Colonial Secretary's Office, Cape Town
1885			Gregory, G. M., Ghazipur, N.W.P., India
1883			‖Grenfell, Claud, M.A., c/o Miss Boole, 16 Ladbroke-road, W.
1874			Greville, Henry Leicester, Diersheim, Churchfields, Woodford
1896			Grice, W. T., 9, Dalhousie-square, Calcutta
1859			Griffith, George, M.A., College-road, Harrow
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 4, Albert-road, Kendal
1874	Trans.		‖Grimshaw, Harry, Sunnyside, North-road, Clayton, Manchester
1880			Grimwood, Robert, London County Council, Chemical and Gas Department, 40, Craven-street, W.C.
1893			Grimwood, Robert George, 17 Dagmar-road, Stroud Green, N.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire.
1895			Grossman, E. H., 12, Alfred-place West, South Kensington, S.W.
1871	Trans.	C.1877-8 V.P. 1899- 1902.	‖Groves, Charles Edward, F.R.S., Kennington-green, S.E.
1901			Groves, W. P., Oldfield Hall, Altrincham, Manchester
1900			Gritton, H. B., The Cottage, Balmain, Sydney, N.S.W.
1897			Grundey, F. R., B.Sc., 10, Thorny-road, Douglas, Isle of Man
1897			Guest, E. Graham, M.A., B.Sc., 5, Churchill, Edinburgh
1895			Gunn, Alex., Duns, Berwickshire
1899			Gurney, E. H., Agricultural College, Gatton, Queensland
1898			Guthrie, Alexander, B.Sc., The Cottage, Bocking, Braintree, Essex
1888	Trans.		Guthrie, Frederick Bickell, Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1897			Guttmann, Oscar, 12, Mark-lane, E.C.
1902			Haas, P., B.Sc., Ph.D., 11, Westbourne-park-road, W.
1874			Habirshaw, W. M., Glenwood Works, Yonkers, New York, U.S.A.
1901			Haddon, H. E., Pamplemousses, Mauritius
1878			‖Hadkinson, John,
1894			Hadley, Arthur, c/o Messrs. Toohey, Ltd., Standard Brewery, Sydney, N.S.W.
1898			Hadley, E. B., 20, Upper Park-fields, Putney, S.W.
1893			‖Hadley, Henry Edwin, School of Science, Kidderminster
1886	Trans.		Haga, Tamemasa, D.Sc., College of Science, University of Tokio, Japan

Date of Election.		
1899		Haigh, Percy, c/o Messrs. J. and J. Lonsdale and Co., Ltd., Longford, Ireland
1881		Hailes, Alfred James de, 15, Red Lion-square, W.C.
1892		Haines, Walter S., Prof., c/o Rush Med. College, Chicago, U.S.A.
1876	Trans.	Hake, H. Wilson, Ph.D., Westminster Hospital Medical School, Caxton-street, S.W.
1893		Hale, Henry Ormsby, Oundle School, Northamptonshire
1891		Hall, A. D., S.E. Agricultural College, Wye, Kent
1891		Hall, Allan T., Ivy Cottage, Willerby, near Hull
1889		Hall, Archibald, 34, Bishopsgate-street, E.C.
1889	Trans.	Hall, John A., Victoria Chemical Works, Victoria, B.C.
1876		Hall, Samuel, East London Soap Works, Bow
1899		‖Hall, S. G., 19, Aberdeen-park, Highbury, N.
1893		Haller, Albin, Prof., 1, Rue de Goff, Paris
1886		Halliburton, William Dobinson, Prof., M.D. Lond., B.Sc., F.R.S., Church-cottage, 17, Marylebone-road, W.
1897		Halliwell, Edward, c/o West Riding Rivers Board, Wakefield
1900		Halstead, R. G., 12, Coleman-street, E.C.
1859		‖Hambly, C. H. Burbridge, "Fairley," Weston, Bath
1890	Trans.	Hambly, Frederick J., c/o The Electric Reduction Co., Buckingham, Que., Canada
1888	Trans.	Hamilton, James C., Arncliffe, Arnside, viâ Carnforth
1898		Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks
1897		Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans.	Hamlet, W. M., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1901		Hammond, H. B., 3, Vicars-close, Lichfield
1877		Hampton, William, 38, Lichfield-street, Hanley
1857		Hanbury, Cornelius, Plough-court, Lombard-street, E.C., and Dynevor House, Richmond, Surrey
1893		Hancock, Ernest Albert, Dalsing Sarai, Tirhoot, Bengal, India
1900		Handcock, W. A., 40, Avenue-road, Highgate, N.
1895	Trans.	Hanes, E. S., 34, Keyes-road, Cricklewood, N.W.
1896		Hanger, R. H., Sutton, Hull
1900		Hanley, John, 97, Salisbury-road, Wavertree, Liverpool
1872	Trans.	‖Hannay, James Ballantine, Cove Castle, Loch Long, N.B., and Whitehall Club, S.W.
1889		‖Hanson, Alfred Miall, The Whalley Abbey Printing Co., Ltd., Whalley, near Blackburn
1901		Hanson, E. K., Mapledene, Hadley Wood, N.
1895		Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on Tees
1897		Harbord, F. W., Surbiton House, Englefield Green, Surrey

Date of Election.			
1859	Trans.	S. 1865-73 V.P. 73-5 80-2, 92-5 P. 1895-7	‖Harcourt, A. G. Vernon, M.A., D.C.L., LL.D., F.R.S., Cowley Grange, Oxford
1863			‖Harcourt, L. F. Vernon, M.A., Haddon House, Weybridge
1887	Trans.	C. 1902-	‖Harden, Arthur, M.Sc., Ph.D., 2, Marlborough-road, Richmond
1902			Harding, H., 20, Stratford-road, Kensington, W.
1885			Hards, W. B., B.A., Board of Education, South Kensington, S.W.
1892			Hardy, J. Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1898			Hargreaves, A. F., Esk Hill, Rosslyn, Midlothian, N.B.
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes
1884			Hargreaves, John, Widnes, Lancashire
1901			Hargreaves, W. A., Government Analyst, Adelaide, S. Australia
1901			Harker, Geo., Central Technical College, S. Kensington
1876			‖Harland, R. H., 37, Lombard-street, E.C.
1878			‖Harland, William Dugdale, 48, King-street, Manchester
1897			Harley, Vaughan, Prof., M.D., 25, Harley-street, W.
1874			‖Harman, F. E., M.R.A.C., c/o Dr. Piggott, 13, Orchard-gardens, Teignmouth, Devon
1897			Harman, Harold W., Shalmsford, Brixton-hill. S.W.
1899			Harper, H. W., M.D., The University of Texas, Austin, Texas, U.S.A.
1897			Harrie H. W., c/o Messrs. Harker, Stagg and Morgan, 15, Lawrence Pountney-lane, E.C.
1897			Harrington, B. J., Prof., M.A., Ph.D., McGill University, Montreal
1881			Harrington, William Bury, Leeview, Montenotte, Cork
1896			Harrington, Wm., 9, Edgehill-terrace, Bransby, Whitehaven
1896			Harris, F. W., Sanitary Chamber, Glasgow
1893			Harris, Harold, c/o Messrs. Dalgety and Co., Ltd., Sydney, N.S.W.
1895			Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia
1874			Harris, Henry Penley, 8, Howard-road, Cricklewood, N.W.
1894			Harris, Sydney Walters, 15, Lansdowne-terrace, Walters-road, Swansea
1878			‖Harris, Thomas Frederick, B.Sc., The Firs, Kennardington, Ashford
1895			Harris, Walter, M.A., Ph.D., Sutherland Institute, Technical School, Loughton, Staffs.
1888			‖Harrison, Albert, 72, Windsor-road, Forest Gate, E.
1895			Harrison, C. E., B.A., Abbey View, Potters-bar, N.
1894	Trans.		Harrison, Edward Frank, 3, Carlton-avenue, Greenhithe, Kent
1883			‖Harrison, Hugh Erat, B.Sc., 28, Sussex-place, Regent's Park, N.W., and Faraday-house, Charing Cross-road

Date of Election.			
1888			Harrison, J. Burchmere, C.M.G., M.A., Government Laboratory, George Town, Demerara, British Guiana
1891			Harrold, Frederick W., 18, Maddox-street, W.
1876	Trans.		Harrow, G. H., Ph.D., Messrs. Allsopp and Sons' Brewery, Burton-on-Trent
1901			Harry, F. J., 106, Sandmere-road, Clapham Common, S.W.
1886			Hart, Bertram Harvey, The Elms, Old Charlton, Kent, S.E.
1869			‖Hart, F. W., Holly House, 96, Stoke Newington-road, N.
1900			Hart, H. W., 13, Lynwood-villas, Darwen, Lancs.
1891			Hart, William Beaumont, Laboratory, 18, Exchange-street, Manchester
1882			Hartley, Arthur, The Brewery, Emsworth, Hants.
1897			Hartley, E. G. J., B.A., Wheaton-Aston Hall, Stafford
1899			Hartley, H. B., B.A., Balliol College, Oxford
1897			Hartley, Thomas, Sexey's Trade School, Bruton, Somerset
1866	Trans.	C.1877-9 V.P.90-3	Hartley, Walter Noel, D.Sc. (Royal Univ., Ireland), F.R.SS., L. & E., F.I.C., Hon. Fellow King's Coll., Lond., Royal Coll. of Science, Stephen's-green, Dublin; and 36, Waterloo-rd., Dublin
1890	Proc.		Hartog, P. J., B.Sc., Owens College, Manchester; and 22, Brondesbury-villas, London, N.W.
1900	Trans.		Harvey, A. W., 13, Pendrell-road, St. Catherine's-park, Hatcham, S.E.
1885			Harvey, Ernest Wm., A.R.S.M., 20, Malwood-road, Balham, S.W.
1881			Harvey, Sidney, Canterbury
1894			Harvey, W. Pellew, 31, Walbrook, E.C.
1894			Hatfield, J. Adams, 89, Bridge-street, Wednesbury
1892			Hatton, William Percy, c/o W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred E., M.D. Bruss., L.R.C.P. Edin., 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, E., M.Sc., 6, Stanley-villas, Runcorn, Cheshire
1898			Haworth, John, 32, Marriott-road, Millhouses, near Sheffield
1900			Haynes, J. H., B.Sc., 73, Boynland-avenue, Bishopstown, Bristol
1887			Head, C. James, F.I.C., 117, Bedford-road, Clapham, S.W.
1891			Heath, John William, 33, Upper Gloucester-place, W.
1898			Heaton, John, 3, Belle Vue-park, Sunderland
1902			Heaton, Noel, B.Sc., 20, Girdlers-road, W. Kensington, W.
1899			Hedley, G. W., M.A., 2, St. Luke's-terr., Cheltenham
1876		C. 1895-9	Hehner, Otto, 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, Simonstone, 27, Hammelton-road, Bromley, Kent

Date of Election.			
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, J. W., 3, Tavistock-road, Croydon
1899			Hemborough, James, Leeds Southern Higher Grade School, Leeds
1900			Hemingway, F. C. R., Albyns, Forest-road, Walthamstow
1898			Hemmy, A. S., Prof., B.A., M.Sc., Government College, Lahore, India
1885	Trans.		‖Henderson, George G., Prof., M.A., D.Sc., F.I.C., the Technical College, 204, George-street, Glasgow
1895			Henderson, James, B.Sc., Ph.D., McGill University, Montreal
1900	Trans.		Henderson, J. B., Government Analyst, Brisbane, Queensland
1892			Hendrick, James, B.Sc., F.I.C., Marischal College, Aberdeen
1901			‖Henley, the Hon. F. R., B.A., 9, Beaufort-gardens, S.W.
1899	Trans.		Henry, T. A., 2, Rigault-road, Fulham
1853			Hepburn, J. G., LL.B., Dartford, Kent
1897			Heppenstall, Charles, 95, Crompton-road, Handsworth, Birmingham
1895			Heriot, T. H. P., Usine St. Madeleine, San Fernando, Trinidad, B.W.I.
1871			Herman, Douglas, Rainhill, Lancashire
1876	Trans.	C. 1892-3	Heron, John, 110, Fenchurch-street, E.C.
1892	Trans.		Hewitt, John Theodore, M.A., D.Sc., Ph.D., 65, Silverdale Sydenham, S.E.
1900			Hewitt, Samuel, 3, Chester-street, Norwich
1900			Hewitt, W. H., B.A., 115, Fentiman-road, S.W.
1892			Hewlett, John C., 40, Charlotte-street, Great Eastern-street, London, E.C.
1883	Trans.	{C. 1897–1901.}	‖Heycock, Charles T., M.A., F.R.S., 24, Fitzwilliam-street Cambridge
1890			Heywood, Joseph H., 231, Drake-street, Rochdale
1848			Heywood, J. S. C., 19, Inverness-terrace, Kensington-gardens, W.
1876	Trans.		Hibbert, Walter, 101, Goldhurst-terrace East, South Hampstead, N.W.
1894			Hichens, J. H., M.A., F.G.S., The School House, Wolverhampton
1881			‖Hiddingh, Michael, Newlands, near Capetown
1901			Higgs, H. H., B.Sc., 26, Anglesey-street, Lozells, Birmingham
1894			Higgs, M. S.,
1882			‖Hill, Alexander,
1858			Hill, Alfred, M.D., F.I.C., F.R.S.E., Medical Officer of Health, The Council House, Birmingham
1896	Trans.		Hill, A. Croft, B.A., 40, Telford-avenue, Streatham-hill, S.W.

Date of Election.			
1896			‖Hill, C. A., 15, Brunswick-gardens, Kensington, W.
1896			Hill, E. G., Prof., B.A., Muir College, Allahabad
1897			Hill, Sydney, 86, Park-avenue, Hull
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, London, S.W.
1892			‖Hills, Harold F., 29, Cavendish Mansions, Clapton-square, N.E.
1898			Hills, T. H., 6, Eliot Park, Blackheath, S.E.
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, J. W., 15, Fawcett-street, S.W.
1900			Hinks, P. J., Tavern-street, Stowmarket
1894			Hirsch, C. T. W., M.D., Charlinch, Rectory-road, Woolwich S.E.
1870			Hislop, G. R., Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, R. F., Craigielea, Paisley
1883			‖Hobbs, Bedo, 75, High-street, Maidenhead
1901			Hobson, Edwin, Howdendyke, Howden, Yorkshire
1884			Hodges, Herbert J., Dagmar, Napier-avenue, Fulham, S.W.
1882	Trans.		‖Hodgkin, John, F.L.S., F.I.C., 12, Dynevor-road, Richmond, S.W.
1879	Trans.	C. 1883-4	Hodgkinson, W. R. Eaton, Prof., Ph.D., F.R.S.E., 18, Glenluce-road, Blackheath, S.E.
1886			Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, H. McAlpin, Caldew Bank, Cummersdale, near Carlisle
1873			‖Hodgson, H. Tylston, Harpenden, Herts.
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D., 62, Avenue des Champs Elysées, Paris
1876			Holcroft, Harold, M.A., Parkdale, Wolverhampton
1901			Holdcroft, George Frederick, 253, Oxford-street, Chorlton-on-Medlock, Manchester
1885			Holgate, Thomas, Rockleigh, Savile-park, Halifax
1876			Holland, Philip, 22, Taviton-street, Gordon-square, W.
1891			Holloman, Frederick R., Southern-road, Plaistow, E.
1886			Holloway, George Thomas, 57 and 58, Chancery-lane, W.C.
1895			Holme, A. E., M.A., The Wheelwright Grammar School, Dewsbury
1897			Holmes, John, Government Laboratory, Clements Inn Passage, W.C.
1886			Holmes, John Winder, Ruyton-xi-towns, Shropshire
1898	Trans.		Holroyd, G. W. F., B.A., Christ Church, Oxford
1893			Holthouse, H. B., 12, Melton-grove, West Bridgford, Notts.
1898			Homfray, David, B.Sc., 6, Dartmouth-row, Greenwich, S.E.
1878			Hooker, A. H., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel C., Spreckel's Sugar Refining Co., Reed-street, Philadelphia, U.S.A.

Date of Election.			
1883			‖Hooper, David, Curator, Economic and Art Section, Indian Museum, 1, Sudder-street, Calcutta
1888			Hooper, E. Grant, 16, Royal-avenue, Chelsea, S.W.
1891			‖Hooper, Ernest F., Wear Fuel Works, South Dock, Sunderland
1894			‖Hornby, R., M.A., King William's College, Isle of Man
1897			Horseman, J. W., County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901			Horton, Edward, 8, Orford-street, Chelsea, S.W.
1892			Horwill, Edgar E. C., 19, Devereux-road, New Wandsworth, S.W.
1886			‖Hoskins, Arthur Percy, 25, Cromwell-road, Belfast
1871			Houlder, W. W., 10, Ossulton-villas, Southall-green, Southall
1901			Houldershaw, Arthur, 7, Lavender-gardens, West Jesmond, Newcastle-on-Tyne
1887	Proc.		Houlding, William, B.Sc., Gilmerton, Cressington-park, Liverpool
1900			Houston, Adam, Brisbane House, Bellahouston, Glasgow
1896			Howard, Albert, Imperial Agricultural Dept. for the West Indies, Barbados, W.I.
1882			‖Howard, Alfred G., Burnt House, Chigwell, Essex
1901			Howard, B. F., Devon House, Buckhurst Hill, Essex
1870		C.1875-8 83-4, 98-1902 V.P. 86-8.	‖Howard, David, Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, D. Lloyd, jun., Little Friday Hill, Chingford, Essex
1889			Howard, George William, Calverley, Tunbridge Wells
1875			Howard, Thomas, 50, Ellington-street, Liverpool-road, N.
1882			Howe, J. Lewis, M.D., Ph.D., Prof. of Chem., Washington and Lee University, Lexington, Va., U.S.A.
1898			Howe, Walter, 45, Spring-gardens, Bradford
1880			Howell, Reginald, 95A, Southwark-street, S.E.
1876			Howie, W. L., Hanover Lodge, West Hill, Harrow.
1889			‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889			Hoyles, Henry Richardson, c/o Messrs. Treacher and Co., Byculla, Bombay, and Fern-place, 142, Upperthorpe, Sheffield
1871			‖Hudleston, W. H., M.A.,
1900			Hudson, E. F., B.A., Churcher's College, Petersfield, Hants.
1878			Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899			Hübner, Julius, 24, Delauney's-road, Crumpsall, Manchester
1901			Hughes, Edward, Rev., The Rectory, Barmouth
1894			Hughes, Frank, 78, Duke-street, Chelmsford
1880	Trans.		Hughes, George Henry, Analytical Laboratory, Barbados, West Indies; and 155, Fenchurch-street, E.C.
1868			Hughes, John, Analytical Laboratory, 79, Mark-lane, E.C.
1896			Hughes, J. A., 1, Bridewell-street, Bristol

Date of Election		
1885		Hughes, T. Vaughan, Norwich Union-chambers, Congreve-street, Birmingham
1882		Hughes, Thomas, Borough Analyst, West Wharf, Cardiff Laboratory, 31, Londoun-square, Cardiff
1879	Trans.	Hummel, J. J., Prof., The Yorkshire College, Leeds, and 152, Woodsley-road, Leeds
1883		Humphrys, Norton H., 4, The Paragon, Wilton-road, Salisbury
1869		Hunt, Charles, Birmingham Gas Light Works, Windsor-street, Birmingham
1883		Hunter, John, 37, Chambers-street, Edinburgh
1885		Hunter, Matthew, M.A. Oxon, Rangoon College, Rangoon, Burma
1878		Huntington, A. K., Prof., Metallurgical Laboratory, King's College, W.C.
1893	Trans.	Huntly, George Nevill, B.Sc., 96, Gower-street, W.C., and 56, Sheen-road, Richmond
1885		Hurst, George H., 22, Blackfriars-street, Salford
1901	Trans.	Hurtley, W. Holdsworth, D.Sc., St. Bartholomew's Hospital, E.C.
1861		Huskisson, H. O., 5, Gordon-square, London, W.C.
1900		Hutchin, H. W., Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, B.A., B.Sc., Bryn-y-Mor, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A., Ph.D., Pembroke College, Cambridge
1884		‖Hutchinson, C. Clark, 8, Cleve-road, Hampstead, N.W.
1901		Hutton, R. S., M.Sc., Owens College, Manchester
1901		Hyder, A. J., 22, Gunton-road, Upper Clapton, N.E.
1900		‖Ichioka, Tajiro, Prof., Kure Arsenal, Japan
1888		Idris, Thomas Howell Williams, Pratt-street, Camden Town, N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1889	Trans.	Ingle, Herbert, Glaramara, Ridge End, Headingley, near Leeds
1901		Ingram, Beresford, 19, Lewisham Hill, Lewisham, S.E.
1897	Trans.	Innes, W. R., Ph.D., M.Sc., Norlands, Victoria-road, Gt. Crosby, Liverpool
1901		Ionides, S. A., Balliol College, Oxford
1883		‖Irwin, Wilfred, 3, Wilton Polygon, Cheetham Hill, Manchester
1892		‖Isaac, John F. V.,
1882		Isherwood, Thomas, M.A., LL.D., D.C.L., University School, Southport
1885		Ivatt, Albert, M.A., "The Engadine," Histon, Cambridge
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex
1883		‖Jackson, A. Henrick, Prof., B.Sc., The Electrical Engineering School, 358, Collins-street, Melbourne, Australia
1894	Trans.	Jackson, David Hamilton, M.A., B.Sc., Ph.D., c/o The Knowle, Blundell Sands, Liverpool

Date of Election.			
1882			Jackson, Edward, Clovelly, Grove Avenue, Moseley, Birmingham
1900	Trans.		Jackson, Henry, M.A., Fellow and Tutor of Downing College, Cambridge
1884	Trans.		Jackson, Herbert, Chemical Laboratory, King's Coll., Strand, W.C.
1892			Jackson, John, Llangorse Villa, Serpentine-road, Gold Tops, Newport, Mon.
1883			Jackson, Robert, 18, Harrington-street, Dublin
1881			‖Jackson, R. Valentine, c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			Jackson, Samuel, c/o Messrs. Binney and Co. (of Madras), 45 Fenchurch-street, E.C.
1887			‖Jadhava, K. B., Baroda, Bombay Presidency, India
1900			Jaffé, Adolf, Broad Oak, Oak-avenue, Bradford
1878	Trans.		Jago, William, F.I.C., Godrevy-house, Wilbury-avenue, Hove, Brighton, and Cornwall-buildings, 35, Queen Victoria-street, E.C.
1895			James, Alfred, 56, New Broad-street, E.C.
1888			‖James, Christopher, Pembrey Copper Works, R.S.O., Burry Port, South Wales
1878			Jamieson, Alexander, 5, St. Mark's-crescent, Regent's Park, N.W.
1879	Trans.	C.1882-4 F.S. 85-91 V.P.95-9	†‖Japp, F. R., M.A., LL.D., F.R.S., The University, Aberdeen
1902			Jardine, D. S., Rathgar-house, Rathgar.
1882			J'Armay, Gustav, Hartford Lodge, Hartford, Cheshire
1898			Jarvis, G. A., The Shrubbery, Snedshill, Wellington, Salop
1898			Jee, E. C., B.Sc., 39, Pepys-road, New Cross, S.E.
1896			Jeffers, E. Haynes, 87, Kyrle-road, West Side, Clapham Common, S.W.
1901			Jemmett, W. H. C., B.A., Tintern, Gap-road, Wimbledon, S.W.
1891	Trans.		Jenkins, Henry C., Gov. Dept. of Mines, Melbourne, Australia
1892			‖Jenkins, John H. B., Chemical Laboratory, G.E. Ry. Works, Stratford, E.
1896			Jenkins, J. P., 30, St. John's-road, Clifton, Bristol
1894			Jenks, R. Leonard, 24, Baskerville-road, Wandsworth Common, S.W.
1900			Jennings, Henry, Marlowes, Hemel Hempstead, Herts.
1894			Jennison, Francis Herbert, 26, Derby Crescent, Kelvinside, near Glasgow
1896	Trans.		‖Jerdan, D. S., M.A., B.Sc., Ph.D., c/o Messrs. J. and G. Cox, Gorgie Mills, Edinburgh
1898			Jessop, S. M., 84, Horbury-road, Wakefield
1879			Jewson, Francis A. B., 9, Hayles Court, Camberwell, S.E.
1901			Johnson, Charles H., M.B., Ch.M., "Beaumont," Northcote, Melbourne

† Longstaff Medallist, 1891.

Date of Election.		
1899		Johnson, E. C., Great Cobar Copper Mining Company, Lithgow, N.S.W.
1895		Johnson, F. E., Holly House, Cottingham, Hull
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), 5, Boulevard Clovis, Bruxelles
1883		Johnson, James Edward, 40, Edmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1886		Johnson, J. T., Durham School, Durham
1897		Johnson, Otis C., Prof., 52, Thayer-street, Ann Arbor, Mich., U.S.A.
1866		‖Johnson, Samuel H., The Warren Hill, Loughton, Essex
1896		Johnstone, James, Braehead, Parkhill, Rutherglen
1892		Johnstone, William George, c/o Messrs. Warwick's, The Brewery, Newark-on-Trent
1901		Jollyman, W. H., Spartan-house, Colney Hatch-lane, Muswell-hill, N.
1898		Jones, Edward, B.Sc., 15, Macaulay-road, Clapham, S.W.
1895		Jones, E. L., The County School, Milford Haven
1871	Trans.	Jones, E. W. T., The Oaklands, Wolverhampton; and 10, Victoria-street, Wolverhampton
1873	Trans.	Jones, Francis, F.R.S.E., Beaufort House, Alexandra Park, Manchester
1894		‖Jones, Geo. Cecil, Basingstoke Ironworks, Basingstoke, Hants
1876	Trans.	‖Jones, H. Chapman, Royal Coll. of Science, S. Kensington, S.W.
1893		Jones, Hedley Gordon, 16, Greenholm-road, Eltham, S.E.
1900	Trans.	Jones, H. O., B.A., B.Sc., Clare College, Cambridge
1878		Jones, Henry Williams, Spencer-park, Coventry
1901		Jones, J. L. T., Major, I.M.S., Byculla Club, Bombay
1890		Jones, John Archyll, B.Sc., 27, Southfield-road, Middlesbrough
1892	Trans.	Jones, Lionel Manfred, Municipal Technical Schools, Birmingham
1899		Jones, L. W., Ph.D., University of Chicago, Chicago, Ill., U.S.A.
1891		Jones, M. William, 8, Cavendish-place, Jesmond, Newcastle-on-Tyne
1896		Jones, R. H., 88, Norwood-road, London, S.E.
1901		Jones, R. H., M.Sc., Neuenheimen Landsen 24, Heidelberg, Germany
1898		Jones, Thomas Hill-, Eagle Wharf-road, New North-road, N.
1893	Trans.	Jowett, Hooper A. D., D.Sc., "Wansfell," Church-avenue, Sidcup, Kent
1891		Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900		Joyce, T. G., B.Sc., c/o Messrs. Lorimer and Co., Ltd., Britannia-row, Islington, N.
1899		Judge, Thomas, M.A., 44, Upper Mall, Ravenscourt-park, W.
1893		Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India

Date of Election.			
1886	Trans.		Kawakita, Michitada, Engineering College, Tokio, Japan
1898			Kay, R. A., Estancia "Cuchillo Co.," La Central Cuchillo Co., Estacion, Bernasconi, Pampa Central, F. C. de Bahiá Blanca, N. Queste, Argentine Republic
1881	Trans.		Kay, William E., Ashlands, Sale, Cheshshire
1889			Kaye, J. R., M.B., Medical Officer of Health, West Riding of Yorkshire, Wakefield
1883			||Keeling, Frank, Dapdune, Guildford, Surrey
1882			||Keen, Austin, Glanbaiden, Trumpington-road, Cambridge
1894			||Kellas, Alex. Mitchell, B.Sc., 24, Cecile-park, Crouch-hill, N., and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874			Kellner, William, Ph.D., Chemical Department, Royal Arsenal, Woolwich, S.E.
1897			Kelly, Charles, The Technical School, Darwen, Lancs.
1867			||Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W
1882			||Kemp, William Joel, Mountfield, Robertsbridge, Sussex
1884			Kendall, George Frederic, B.A., The Hollies, Stratford-upon-Avon
1874			Kendall, James Alfred, Lonesome Chemical Works, Streatham Common, S.W.
1889			Kenwood, Henry R., M.B., C.M. (Edin.), L.R.C.P. (Lond.), 9, Alexandra-villas, Finsbury Park, N.
1895			Kenyon, Rich. E., M.Sc., 27, Bromar-road, Denmark-park, Camberwell, S.E.
1883			Kerry, William H. R., The Sycamores, Windermere
1900			Kershaw, J. H., Sewage Works, Rotherham, Yorks.
1901			Kettle, J. D., 1, Vardens-road, St. John's-hill, S.W.
1895			Kibble, W. O., Golden Eagle G.M. Co., Hayden-hill, Larsen Co., California, U.S.A.
1901			Kiddell, C. G., B.A., 24, Queen's-gardens, Muswell Hill, N.
1882			Kilner, Frederick James, 228, Roundhay-road, Leeds
1900			Kilner, G. W., M.A., 14, St. John's-park, Upper Holloway, N.
1884			Kilpatrick, W. Stirling, 6, Colebrook-street, Hillhead, Glasgow
1872	Trans.	C. 1887-92	||Kinch, Edward, Prof., Royal Agricultural College, Cirencester
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1897			King, Herbert, B.Sc., 8, Avenue-road, Scarborough
1876			King, J. Falconer, Laboratory of City Analyst, 20, Chambers-st., Edinburgh
1895			Kingdon, G. Holman, M.A., c/o Messrs. Crosfield, Limited, Warrington, and Ivy Lodge, Froghall, Warrington
1872	Trans.		||Kingzett, Charles T., Elmstead Knoll, Chislehurst, Kent
1899			Kinnersley, H. W., 70, Minford-gardens, Shepherd's Bush, W.
1895			||Kinnicut, Prof. L. P., 77, Elm-street, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	||Kipping, F. Stanley, Prof., Ph.D., D.Sc., F.R.S., University College, Nottingham

Date of Election.		
1886		Kirby, Herbert E., St. Margaret's Mansions, Victoria-street, S.W.
1890		Kirk, Oliver, 19, Carlton-road, Workington
1895		‖Kirkaldy, Patrick H., Chemical Department, King's College, W.C.
1873		‖Kitchin, Archibald, F.I.C., Scragill House, Whitehaven
1889		Kitchin, John, The Middlesex Hospital, W.C.
1888		‖Knaggs, Alfred Battye, 2, Bradley-lane, Huddersfield
1889		Knight, Frederick Charles, Boston and Colorado Smelting Company, Argo, Colorado, U.S.A.
1894		Knight, James, M.A., B.Sc., St. James's School, Carlton, Glasgow
1896		Knight, J. B., Bushwood, Wanstead, Essex
1894		Knight, Wm. Albt., Sexey's Trade School, Bruton, Somerset
1878		Knights, James West, County Laboratory, Cambridge
1879		Knowles, Joshua, Stormer-hill, Tottington, Bury
1892		Knowles, Thomas Torrens, M.A. (Cantab.), 27, Peel-street, Princes Park, Liverpool
1864		Knox, G. W., B.Sc., 16, Finsbury-circus, London, E.C.
1873		Koch, Walter Edward, M.A., F.G.S., Lustre Mining Co., Santa Maria del Oro, Estava de Durango, via Parral, Mexico
1887	Trans.	Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1886	Trans.	Kohn, Charles A., Ph.D., B.Sc., Sir John Cass's Technical Institute, Aldgate, E.C.
1885		Koningh, Leonard de, [illegible], St. Martin's Road, Stockwell, S.W.
1892		Krause, Dr. G., Cothen, Germany
1859	Trans.	Kynaston, Josiah W., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900		Kynaston, W.C.R., 9, Harland-road, Higher Tranmere, Birkenhead
1888		Lafosse, Charles R., 407, Oxford-street, Manchester
1893		Lamb, Edmund George, M.A., Borden Wood, Liphook, Hants.
1900		Lamb, M. C., Harold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.	‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893		Lambert, Wesley J., 55, Plumstead Common-road, Plumstead, S.E.
1877		Lancaster, William James, F.R.A.S., F.R.C.S., F.R.M.S., Pine Crest, Burnt Green, Worcestershire
1900	Trans.	Lander, G. Druce, 1, Balmoral-road, Nottingham
1886		Lang, William, Cross Park, Partick
1897	Trans.	Lang, W. R., Prof., D.Sc., University of Toronto, Canada
1896		Lange, E. F. S., Fairholm, Willow Bank, Fallowfield, Manchester
1885		Langer, Charles, Ph.D., Ynyspenllwch, Clydach, R.S.O., Glamorganshire

Date of Election.		
1891		‖Langham, Rev. E. Norman, M.A. (Cantab.), F.L.S., Head Master, Rastrick Grammar School, Brighouse
1894	Trans.	Lapworth, Arthur, D.Sc., The Goldsmiths' Institute, New Cross, S.E.
1901	Proc.	Larter, A. T., 184, Holland-park-avenue, W.
1883		Lascelles, B. P., B.A., Longridge, High-street, Harrow-on-the-Hill
1880		Last, Frank B., Laboratory, 78, Mansell-terrace, Swansea
1901		Lattey, R. Tabor, Trinity College, Oxford
1891	Trans.	Lauder, Alexander, University College, Bangor, North Wales
1886	Trans.	Laurie, Arthur P., Monk Wood Cottage, Baldwin Hill, Loughton
1899		Laurie, D. Northall, 57, Sloane-gardens, Chelsea, S.W.
1902		Lavelle, Selwyn P. J., Royston-villa, Burton-on-Trent
1876		‖Law, Channell, Ilsham Dene, Torquay
1890	Trans.	‖Law, Robert, F.I.C., The Royal Mint, Melbourne
1896	Trans.	Lawrence, W. Trevor., B.A., Ph.D., 57, Prince's Gate, S.W., and Owens College, Manchester
1900		Laws, A. R., 95, Gloucester-street, Newcastle-on-Tyne
1882		Laws, J. Parry, F.I.C., 2, Aigburth-vale, Liverpool
1888	Trans.	‖Lawson, Thomas Atkinson Ph.D., B.Sc., 90, Boundary-road, London, N.W.
1890	Trans.	‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890		Lea, A. Sheridan, D.Sc., F.R.S., Sunnyside, Sidcup, Kent
1886		‖Leach, Walter, 21, St. Andrew's-place, Bradford
1902		Leahy, A. W. D., Major, Darjeeling, India
1894	Trans.	‖Lean, Bevan, D.Sc., B.A., Laurel Bank, Ackworth, near Pontefract
1888		Lease, Frank E., Melapi Estate, Sandakan, British North Borneo
1891	Trans.	Leather, J. Walter, Ph.D., Dehra Dunn, N.W.P., India
1900		‖Leathes, John Beresford, M.A., M.B., 10, Park-mansions, Battersea-park, S.W.
1889		Ledingham, L. Napier, Govandale, Elmore-road, Sheffield
1883		Lee, Herbert C., The New Westminster Brewery Company, Earl street, Horseferry-road, S.W.
1898		Lee, H. L., Chemical Instructor, Rajkot, Kathiawar, Bombay
1883		Lee, Robert Brewer, B.Sc., B.A., 6, Warwick-street, Kensington, W.
1897	Proc.	Lee, T. H., St. John del Rey Mining Co., Ltd., Morro Velho, Villa Nova de Lima, Estada de Minas, Geras, Brazil
1891		Leeds, Frank H., 26, East Bank, Stamford-hill, N.
1899		Leeming, W. T. L., 19, Queen-street, Ton Pentre, Glam.
1873		Lees, Charles, Devonshire House, Bridlington Quay, Yorks.
1891		Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889		‖Legg, John Edmund, M.A., F.I.C., The Grammar School, Woodbridge, Suffolk

Date of Election.			
1901			Lehmann, A. L. F., B.Sc., Ph.D., Bangalore, Mysore, India
1891	Proc.		Leicester, James, Ph.D., Ivor House, Old Normanton, Derby
1889			Leigh, Cecil, Birmingham Metal and Munitions Company, Adderley Park Rolling Mills, Birmingham
1897			Lemmey, Tom, Rev., B.A., Wellington College, Berks
1891			Lennox, Robert N., The Nook, Rose Bank, Crabb Tree, Fulham
1899			Leon, A. A., 13, Cleveland-square, Hyde-park, W.
1882			Lescher, Frank Harwood, 60, Bartholomew-close, E.C., and 31, Devonshire-place, W.
1895	Trans.		Le Sueur, Henry Rondel, B.Sc., St. Thomas's Hospital, S.W.
1896			Lethbridge, W. A., 14, Sydney-street, Basford-park, Stoke-on-Trent
1899			Lett, S. J., 25, Percy-street, Liverpool, and 72, Clarendon-road, Holland-park, W.
1879	Trans.		Letts, Edmund Albert, Prof., D.Sc., Ph.D., Queen's College, Belfast
1888	Trans.		Lewes, Vivian B., Prof., 19, Park-row, Greenwich, S.E.
1898			Lewins, William, B.Sc., Higher Primary School, Technical Institute, Blackburn
1901			Lewis, E. A., 310, Dudley-road, Birmingham
1899			Lewis, E. W., 64, Ommaney Road, New Cross, S.E.
1894	Trans.		Lewis, W. H., Exeter School, Exeter
1869	Trans.		‖Lewis, W. J., New Museums, Cambridge
1888	Trans.	C. 1902–	Lewkowitsch, Julius, Ph.D., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, T., Chemical Works, Silvertown, E.
1896			Lidgey, C. R., 11, St. Peter's-road, Harborne, Birmingham
1900			Liebmann, Adolf, M.A., Ph.D., 33, Clyde-road, Didsbury, Manchester
1901			Linde, H. T. G., van der, 101, Tyndall-avenue, Toronto, Canada
1892			Lindley, Hubert Edward, Rose Villa, Pinner-road, Harrow
1899			Lindsay, R. W., 22, Hilldrop-crescent, Camden-road, N.
1886	Trans.		Ling, Arthur R., 45, Lambton-road, Cottenham Park, Wimbledon
1899			Linstead, E. F., 15, Station-avenue, Winchmore-hill, W.
1853	Trans.	V.P. 1883-6 1898-1901	‖Liveing, G. D., Prof., M.A., F.R.S., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof., F.R.S., University, Sydney, New South Wales, and The Octagon, St. Mark's-road, Darling Point, Sydney, Australia
1883			Livingston, W. J., London County Council, Spring-gardens, S.W.
1880			‖Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.		Lloyd, F. J., Muscovy House, 6, Trinity-square, E.C.
1893			Lloyd, Herbert, Allegheny Avenue, and 19th-street, Philadelphia, U.S.A.

Date of Election.		
1896		Lloyd, T. H., 121, Kingsley-road, Princes-park, Liverpool
1900		Lockhart, T. L., P.O. Box 231, Glencairn Main Reef Gold Mining Co., Ltd., Germiston, Transvaal
1896		Lockwood, T. W., Heckmondwike, Yorkshire
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1901		Loewenthal, Oscar, 18, Heathfield-road, Mill Hill Park, W.
1884		London, J. Edward, M.D., 62, Main-street, George Town, Demerara, W.I.
1872		‖Longstaff, George Blundell, M.A., M.B. Oxon., M.R.C.P., Highlands, Putney Heath, S.W.
1873		‖Loram, H. Y., 49, Buxton-road, Chingford, Essex
1878	Trans.	‖Louis, D. A., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward G., Ph.D., 80, East 55th-street, New York, U.S.A.
1882		‖Lovibond, Thomas Watson, F.I.C., Hesleyside, Bellingham, R.S.O., Northumberland
1884		Low, Charles William, M.B., Stricklands, Stowmarket, Suffolk
1878		‖Lowe, Walter Bezant. M.A., Stranraer School, Fareham, Hants
1876		Lowe, William Foulkes, A.R.S.M., 9 Hough-green, Chester
1898	Trans.	‖Lowry, T. M., B.Sc., 44, Blenheim-crescent, W.
1901		Lowson, William, B.Sc., 83, Kyle-road, Clapham-common, S.W.
1899		Lucas, Alfred, Survey Department, Public Works Ministry, Cairo, Egypt
1902		Lucas, Harry, 1, St. Agnes'-place, Kennington-park, S.E.
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, and Southville, Swansea
1877	Trans.	‖Luff, A. P., M.D., B.Sc. (Lond.), 9, Queen Anne-street, Cavendish-square, W.
1890	Trans.	Lumsden, John S., D.Sc., Ph.D. (Mun.), 19, Blackness-avenue, Dundee
1867	Trans.	‖Lunge, Prof. Dr. G., Englischviertelstrasse 22, Zürich, Switzerland
1890	Trans.	Lunt, Joseph, B.Sc., Royal Observatory, Cape of Good Hope
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles M., D.Sc., University Extension College, and Kennet View, Mansfield-road, Reading
1899		Luxton, Thomas, B.A., B.Sc., 28, Albany-street, Hull
1873		Lyon, I. B., Brigade Surgeon, Lieut.-Col., C.I.E., East India U.S. Club, 16, St. James's-square, S.W., and 164, Sutherland-avenue, W.
1874		Lyon, J. G., The Aire Tar Works, Knottingley, Yorks.
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72 Brainard-street, Detroit, Mich., U.S.A.
1859		‖Lyte, F. Maxwell, M.A. (Cantab.), F.I.C., A.I.C.E., Hon. F.P.P.S., 60, Finborough-road, South Kensington, S.W.

Date of Election.		
1888		Maben, Thomas, West of Scotland College of Pharmacy, 23, Doune-terrace, Glasgow
1896		Macadam, H. E., Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson, J. C. G., jun., Surgeons' Hall, Edinburgh
1878		Macadam, W. Ivison, F.R.S.E., Professor New Veterinary College, Surgeons' Hall, Edinburgh
1899		McAlley, James, Bankside, Falkirk, N.B.
1886		Macan, Hugh, M.A., County Hall, Kingston-on-Thames
1900		Macara, Thomas, 6, West Bank-terrace, Hillhead, Glasgow
1890		‖MacArthur, J. Stewart, 45, Renfield-street, Glasgow
1887		‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1888		McBretney, Edmund G., 23, Ferrybridge-road, Castleford, York
1900		M'Call, William, Gran Via 30, 1° Dcha, Bilbao.
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1890	Trans.	McConnell, Arthur H., 35, Bernard-street, Russell-square, W.C.
1899		McConnell, William, 178, Springfield-road, Glasgow
1875		‖McCowan, William, F.I.C., Dunedin House, Basinghall-avenue, E.C.
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D., The Yorkshire College, Leeds
1895		McCreath, James, West Cornwall Creamery, Lelant R.S.O., Cornwall
1899		McCreath, W. D., West Cornwall Creamery, Lelant R.S.O., Cornwall
1890		‖McCubbin, William A., 35, The Temple, Dale-street, Liverpool
1897		MacCulloch, Charles, Fir-grove, Gladstone-road, Auckland, N.Z.
1894		McCutcheon, Jas., Glencorra, Lanark
1901		Macdonald, F. G., Government Laboratory, Durban, Natal
1894	Trans	MacDonald, G. W., M.Sc., c/o Curtis and Harvey, Ltd., Dartford, Kent
1901		Macdonald, P. E., Lapstone-road, Millom, Cumberland
1891		MacDonald, William G., c/o Dr. C. C. Stuhlmann, Tung Wen Kwan, Peking
1874		McDougall, John, Clifton House, Greenwich Park, S.E.
1886		MacEwan, Peter, 37, Hornsey-lane Gardens, N.
1898		McEwen, A. F., 1, Northbrook-road, Lee, S.E,
1895		MacFarlane, Alex., 43, Filey-road, Fallowfield, Manchester
1891		Macfie, R. A. Scott, M.A. (Cantab.), B.Sc., 34, Moorfields, Liverpool
1895		McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.	McGowan, George, Ph.D., 3, Mount-avenue, Ealing, W.
1893		McGregory, Joseph Frank, Prof., Colegate University, Hamilton, New York, U.S.A.

Date of Election.			
1890			Macintyre, Alfred E., The Telegraph Publishing Co., St. John, New Brunswick
1890			Mackean, William, 14, Palmer-street, Westminster, S.W.
1900			McKenzie, A. E., 11, Bank-road, Workington.
1901	Trans.		McKenzie, Alex., M.A., D.Sc., Ph.D., Jenner Institute, Chelsea-gardens, S.W.
1897	Trans.		Mackenzie, J. E., D.Sc., Ph.D., Birkbeck Institution, Chancery lane, E.C.
1902			Mackenzie, John Ross, 31, Bailey-street, Ton Pentre, S. Wales
1899			Mackenzie, Thomas, 4, Church-street, Inverness
1900			Mackenzie, T. E., 6, Cardonald Park-terrace, Cardonald, Renfrewshire
1892			Mackenzie, Dr. William Cossar, Tewfikich College of Agriculture, Gheezeh, Cairo
1893			McKerrow, Charles Alexander, 8, Exchange-street, Manchester
1892			McKerrow, William James, D.Sc., Messrs. Field and Co., Upper Marsh, Lambeth, S.W.
1901			McLaren, Daniel, Brookdale, Grey-street, Stalybridge
1897	Trans.		Maclaurin, J. S., D.Sc., Woodside-road, Mount Eden, Auckland N.Z.
1868	Trans.	C. 1871-3 80-3 95-9 V.P. 87-90 1901-	‖McLeod, Herbert, Prof., F.R.S., 9, Coverdale, Montague-road, Richmond, Surrey
1899			MacLeod, James, West Hill, Cardross-road, Dumbarton
1879			‖Macmillan, J. Laker, 17, Clarence-street, Grosvenor-square, Sydney, N.S.W.
1897			Macmullen, Alan, B.A., 82, James-street, Dublin
1881			MacMunn, Charles A., M.A., M.D., F.R.M.S., Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, Cobar Copper Works, Lithgow, N.S.W.
1880			Macnab, William, Edinburgh Lodge, Howick-place, Victoria-street, Westminster, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D., B.Sc., Fairholm, Ferry-road, Edinburgh
1900			McNair, Hugh, Gas Engineer, Renton, Dumbartonshire
1864	Trans.		‖Mactear, James, F.R.S.E., 28, Victoria-street, Westminster, S.W.
8899			Main, Hugh, B.Sc., 131, Windsor-road, Forest-gate, Essex
1900			Mair, William, 7, Comiston-road, Edinburgh
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1885			‖Mallet, F. R., 20, King's-avenue, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, J. W., Prof., Ph.D., M.D., F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.

Date of Election.			
1897			Mallinson, W. L., Gawthorp-green, Kirkheaton, near Huddersfield
1896			Manners, Hugh, M.A., B.Sc., Academy House, Airdrie, N.B.
1897			Mansford, C. J., B.A., Lady Manner's Grammar School, Bakewell
1895			‖Marchant, Robert Charles, P.A.S.I., M.R.A.C., 11, Osborne-road, Clifton, Bristol
1896			Marks, E. Seaborn, Australian Club, Sydney, N.S.W.
1895			Marsden, Prosper H., University College, Liverpool
1881			‖Marsh, Charles W., Ph.D.
1883	Trans.	C. 1902–	Marsh, J. E., M.A., University Museum, Oxford
1895			Marshall, Arthur, Hope Cottage, Church-hill, Loughton.
1890	Trans.		Marshall, Hugh, D.Sc., F.R.S.E., Chemical Department, University of Edinburgh
1896			Marshall, P. S., Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, Analytical Laboratory, 20, Cullum-street, Fenchurch-street, E.C.
1890	Trans.		Marshall, T. Rhymer, D.Sc., 19, Sandyford-place, Glasgow
1888	Trans.		Marshall, William, 35, Streathbourne-road, Balham, S.W.
1887			Marshall, William, F.I.C., 149, Drake-street, Rochdale
1893			Martin, Alexander Mitchell, Douglas Villa, Dunbeth-road, Coatbridge
1897			Martin, C. H., 14, Aldred-street-crescent, Salford
1902			Martin, Francis, 64, Samuel-street, Woolwich
1898	Trans.		‖Martin, G. H., M.A., 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Lieut.-Col. Gerald Ward, F.R.G.S., 8, Petersham Terrace, Gloucester-road, S.W.
1901			Martin, N. H., Ravenswood, Low Fell, Gateshead
1883			Martin, W. H., 183, King's-road, Chelsea, S.W.
1871			‖Martineau, George, 21, Mincing-lane, E.C., and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Northwood, Rydal-road, Streatham, S.W.
1898			Mascarenhas, J. C., 21, Rutland-road, Upton Park, E.
1851	Trans.	C. 1858-9, 756- V.P. 78-80	Maskelyne, Nevil Story, F.R.S., Salthrop, Wroughton, Wilts
1890			Mason, Francis H., Queen-buildings, Hollis-street, Halifax, Nova Scotia
1858			‖Mason, James, Eynsham Hall, Witney, Oxon.
1889			Mason, James Braik, The West End Laboratory, Dundee
1880			Mason, William Brandwood, 117, Derby-street, Bolton
1882	Trans.		Masson, Orme, M.A., D.Sc., Prof., The University of Melbourne, Victoria
1897			Masters, Edward, 32, Dulveston-road, Leicester
1873			‖Masters, William, St. Erme, Moorend Park-road, Cheltenham
1897			Mathews, J. A., M.A., M.Sc., 4, First-place, Brooklyn, N.Y., U.S.A.

Date of Election.			
1896			Mathieson, L. W., North Wilts Technical School, Swindon
1876	Trans.		‖Matthews, C. G., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1880	Trans.		‖Matthews, Francis Edward, Ph.D., Coopers Hill, Englefield Green, Surrey
1884			‖Matthey, Edward, 78, Hatton-garden, E.C.
1870		C. 1877-8	Matthey, George, F.R.S., 78, Hatton-garden, E.C.
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. Camb., B.Sc. Lond., 29, Woolwich-common, S.E.
1896			Mayfield, A. S., 14, Beresford-avenue, Newland, Hull
1892			Meacham, Chas. Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, S.A.
1898			Meads, C. J., Glen Dart, Darmouth, Devon.
1901			Mees, C. E. K., Ryelands, Caterham
1896			Meggitt, Loxley, The Laboratory, Sutton-in-Ashfield, Notts.
1871	Trans.	C. 1883-6, 90-91 F.S. 91-1902 V.P. 1902-	‖Meldola, Raphael, Prof., F.R.S., 6, Brunswick-square, W.C.
1895			Meldrum, Robt., High Bank, Foyle-road, Blackheath, S.E.
1894			Melland, Godfrey, B.Sc., Technical School, Swansea
1875			Melmore, Pattinson B., Chemical Laboratory, Maryport
1900			Menzies, A. W. Cranbrook, M.A., B.Sc., 11, Howe-street, Edinburgh, and 47, Gordon-place, Kensington, W.
1901			Menzies, James, 39, Winterbrook-road, Herne-hill, S.W.
1884			Mercer, Francis M., 89, Bishopsgate-street-within, E.C.
1889			Mercer, Thomas, Great Hey, Edenfield, near Bury, Lancashire and Ring Bank Brewery, Edenfield, near Bury
1901			Meredith, William, 63 Albion-place, Ulverston, Lancs.
1896			Merrett, W. H., Hatherley, Grosvenor-road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland Park, Sheffield
1897			Merson, G. F., 24, Newgate-street, Newcastle-on-Tyne
1876	Trans.	C. 1884-7, 1897-1901	‖Messel, Rudolph, Ph.D., 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans., Ph.D., 1, Salmgasse, Prag, Austria
1888	Trans.	V.P. 1901-	‖Miers, Henry A. Prof., M.A., F.G.S., F.R.S., Magdalen College, Oxford
1892	Trans.		Millar, James Hill, The Laboratory, St. James' Gate Brewery, Dublin
1843			‖Millar, James,
1901			Millard, C. K., Gilroes, Groby-road, Leicester
1891			‖Millard, Edgar J., F.R.M.S., Elyne House, Elyne-road, Stroud Green, N.

Date of Election.			
1880	Trans.		‖Miller, A. K., Ph.D., Kilvert's-buildings, Withy-grove, Manchester
1897			Miller, E. H., M.A., Ph.D., Columbia University, New York City, U.S.A.
1902			Miller, Edward Holl, Finsbury Technical College, Leonard-street, City-road, E.C.
1889			Miller, Harry East, Ph.D., 1015, Chestnut-street, Oakland, California
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc., Ph.D., 44 & 45, Lewis Block, Buffalo, New York, U.S.A.
1885	Trans.		‖Miller, N. H. J., Ph.D., Harpenden, Hertfordshire
1898			Miller, W. Lash, B.A., Ph.D., 50, St. Alban-street, Toronto, Canada
1896			Miller, W. M., Caledonia Estate, Wellesley Province, Penang, S.S.
1893	Trans.		‖Mills, Charles, The Maples, 188, Bedford-hill, Balham, S.W.
1862	Trans.	C. 1868-71, 75-6, 80-3	‖Mills, E. J., D.Sc., LL.D., F.R.S., Emeritus Professor of Technical Chemistry, 11, Greenhill-road, Harrow
1898	Proc.		Mills, W. H., M.A., Jesus College, Cambridge
1885			‖Milne, Alexander, Major I.M.S., M.A., M.B., H.M.'s Mint, Bombay
1877			Milne, G. A., The Poplars, Walkley, Sheffield
1887			Mingaye, John C. H., Department of Mines, Assay Branch, Sydney, N.S.W.
1899			Mirrlees, Arthur, B.A., Redlands, Kelvinside, Glasgow
1898			‖Mitchell, A. H., B.Sc., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1891	Proc.		Mitchell, Charles Ainsworth, B.A. Oxon., c/o Messrs. Beaufoy and Co., South Lambeth-road, S.W.
1897			Mitchell, Tom, Cemetery House, Shaw, near Oldham
1896			Mitra, Asutosh, Rai Buhadur, Chief Medical Officer, Kashmir
1899			Mohr, Bernard, Ph.D., 69A, Parliament Hill, Hampstead, N.W.
1901	Proc.		Moir, James, M.A., B.Sc., Central Technical Institute, South Kensington, S.W.
1893			Mole, H. Bloome, Hill Side, Shepton Mallet
1899			Molson, J. Cavendish, M.D., L.R.C.P., 10, Walsingham-terrace, West Brighton
1872	Trans.	C. 1884-5 V.P. 87-90, 94-8	‖Mond, Ludwig, Ph.D., F.R.S., 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A., F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.

Date of Election.			
1879			‖Mondy, Edmund F., Principal, Dacca College, Dacca, Bengal
1887	Trans.	C. 1899-1900	‖Moody, G. Tattersall, D.Sc., Lorne House, North Dulwich, S.E.
1897			Moon, P. G. G., The Laboratory, British Gas Light Co., Ltd. Norwich
1892			‖Moor, Cresacre George, B.A., 4, Dane's Inn, Strand, W.C.
1891			Moore, Frederick Herbert, Strada degli Argentieri, 19, Messina, Sicily
1896			Moore, L. C., 85, Perkin's Hall, Harvard University, Cambridge, Mass., U.S.A.
1895			Morgan, D. J., 61, Elgin Mansions, Maida Vale, W.
1897			Morgan, F. F. de, 66, Clapham-road, S.W.
1898	Trans.		‖Morgan, G. T., D.Sc., Royal College of Science, South Kensington, S.W.
1888			‖Morgan, John James, 28, London-road, Neath
1900			Morgan, J. Livingston R., M.A., Ph.D., B.Sc., Adjunct Professor of Physical Chemistry, Columbia University, N.Y., U.S.A.
1893			Morgan, J. R., 57, Coldstream-street, Llanelly
1895			Morison, James, Colonial Sugar Co., Ltd., 5, O'Connell-street Sydney, N.S.W.
1880	Trans.		Moritz, Edward R., Ph.D., 45, Great Tower-street, E.C.
1879	Trans.	C. 1887-9 96-1900	‖Morley, H. Forster, M.A., D.Sc., 5, Lyndhurst-road, South, Hampstead, N.W.
1895	Trans.		Morrell, R. S., M.A., Ph.D., Gonville and Caius College, Cambridge
1892			Morris, Albert, B.Sc., Fern Bank, Dukinfield
1900			Morris, E. F., M.A., Grey House, Barrington-road, Altrincham, Cheshire
1900			Morris, H. Newall, Gorton Brook Chemical Works, Manchester
1891			Morris, Joseph, Ph.D., 8, Boardman-street, Eccles, Manchester
1891			Morrison, George R., c/o Messrs. E. Ryan and Co., Ltd., Pope's Quay, Cork
1851			Morson, Thomas, 133, Southampton-row, Russell-square, W.C.; and 42, Gordon-square, W.C.
1872			Morton, Edward Handfield, 11, Exeter-road, Brondesbury, N.W.
1893			Morton, Frederick, 101, Quarmby-road, Huddersfield
1890	Trans.		Mosenthal, Henry de, 220, Winchester House, Old Broad-street, E.C.
1896			Moss, Frank A., Menzies, Western Australia
1871			‖Moss, John, 39, Tressillian-road, St. John's, S.E.
1871			‖Moss, Richard J., F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, W. E., 35, Princes-avenue, Liverpool
1896			Mothe, J. T. de la, Grand Bacolet Estate, St. David's, Grenada, W.I.

Date of Election.			
1886			Moul, Frank, Aldersgate Chemical Works, Southall
1884			‖Moyle, R. E., M.A., Heightley, Chudleigh, South Devon
1889			Muir, James, South Haven, Beach-road, Weston-super-Mare
1896			Muir, J. Stanley, B.Sc., 8, Westminster-gardens, Hillhead, Glasgow
1871	Trans.	C. 1890-4	Muir, M. M. Pattison, M.A., Fellow and Prælector in Chemistry, Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc., The Lodge, Shortlands, Kent
1859	Trans.	C. 1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D., F.R.S., 110, Bunhill-row, E.C.; and 13, Park-square East, Regent's Park, N.W.
1902			Müller, C., 10, Selwyn-avenue, Richmond, S.W.
1893	Proc.		Munby, Alan E., Felstead School, Essex
1902			Mundey, Alfred H., 17, St. Margaret's-road, Plumstead, S.E.
1871			‖Munro, Donald, M.D., C.M., D.P.H., Medico-Legal Department, University of Glasgow
1876	Trans.		Munro, J. M. H., D.Sc., 133, Kennington-road, S.E.
1888			Munroe, Charles E., Prof., Columbia University, Washington, D.C., U.S.A.
1900			Munton, F. T., The Oak House, Winsford, Cheshire
1901			Murphy, A. J., 11, Lyddon-terrace, Leeds
1893			Murray, J. Alan, B.Sc., 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894			Murray, John Moore, Municipal Technical School, Arundel-street, Portsmouth
1890	Trans.		‡‖Murray, Thomas Smith, D.Sc., 1, Nelson-street, Dundee
1869			‖Muspratt, E. K., Seaforth-hall, near Liverpool
1873			‖Muspratt, Sidney Knowles, 9, Church-street, Flint, North Wales
1896			Muter, A. H. M., A.I.C. Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey.
1870	Trans.		‖Muter, John, Ph.D., F.R.S.E., F.I.C., Laboratory, 325, Kennington-road, London, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.		Myers, William Shields, M.Sc., Associate Prof. of Chemistry, Rutger's College, 15, Union-street, New Brunswick, N.J., U.S.A.
1887			Nagel, David Henry, M.A., Trinity College, Oxford
1899			Nance, J. Trengove, B.A., The Steps, Bromsgrove, Worcestershire
1874			‖Napier, Arthur S., Prof., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinand strasse, Berlin
1893			Napier, John Watson, Gas Works, Carnoustie, N.B.
1900			Napper, S. Scrivener, 144, Highbury New Park, N.
1898			Nash, L. M., 17, Lower Park-road, Belvedere, Kent
1900			Naylor, E. Brooks, M.Sc., 73, Castle-street, Bolton
1891			Naylor, William, 16, Walton's-parade, Preston

Date of Election.		
1878	Trans.	Naylor, W. A. H., 38, Southwark-street, S.E.
1899		Neale, H. A., Brentwood, Clothorn-road, Didsbury, Manchester
1901		Neil, A. T., B.A., 21, South-grove, Highgate, N.
1898		Neilson, A. M., 38, Brisbane-street, Greenock
1901		Neumann, Edgar, B.A., Ph.D., 10, Randolf-crescent, Maida Vale, W.
1878	Trans.	‖Nevile, R. H. C., Wellingore Hall, Lincoln
1871	Trans.	Nevill, Edmund Neville, Gov. Lab., Durban, Natal
1890	Trans.	Neville, Francis Henry, F.R.S., Sidney College, Cambridge
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, Balliol College Laboratory, Oxford
1864		‖Newlands, B. E. R., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William, P. R., 232, Amesbury-avenue, Streatham-hill, S.W.
1889		Newsholme, G. T. Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, G. S., Royal College of Science, South Kensington
1895		Newton, C. B., Gas Works, Carlisle
1883		Newton, William, Ph.D., F.I.C., 39, Mincing-lane, London, E.C.
1899		Nicholls, W. W. S., B.Sc., 230, Brockley-road, Brockley, S.E.
1870	Trans.	‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., 1, Huskisson-street, Liverpool
1889		Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892		Nickolls, J. Bate, The Laboratory, Guernsey
1883	Trans.	Nicol, W. W. J., 15, Blacket-place, Edinburgh
1900		Nightingale, T. M., B.Sc., 375, Bridgman-street, Bolton
1898		Nightscales, T. A., 13, Spring-street, Hull
1894		Nixon, Alf., Central School, Deansgate, Manchester
1869		Noble, Captain Sir Andrew, K.C.B., F.R.S., Jesmond Dene-house, Newcastle
1889		Norman, John T., Avalon, Putney Common, S.W.
1861		Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892		Norris, Charles James, Lezayne, Thornton-avenue, Chiswick, W.
1897	Trans.	North, Barker, Glenholme, Glenholme-road, Manningham, Bradford
1892		Northing, John, The Murrough, Wicklow
1854		Norton, Fletcher, Longtown, Abergavenny
1878		‖Norton, T. H., Prof., Ph.D., D.Sc., c/o The John Crerar Library, Chicago, Ill., U.S.A.
1891		Notter, J. Lane, M.A., M.D., West Cliff, Woolston, Southampton
1901		Nunn, A. W., 313, Sydenham-road, Sydenham, S.E.
1893	Proc.	Oates, William Henry, Broomhall Park, Sheffield
1890		Oddy, Robert Walter, Waterhouse, Toad-lane, Rochdale
1873		Odling, Walter, Askew-house, Repton; and Messrs. Bass and Co., Burton-on-Trent

Date of Election.			
1848	Trans.	S. 1856-69 V.P. 1869-72 P. 73-5	Odling, William, Prof., M.A., M.B., F.R.S., 15, Norham-gardens, Oxford
1902			Ogilvie, Allan, 19, Market-street, Millom, Cumberland
1901			Oldershaw, William, Market-place, Nottingham
1889			O'Mahony, D. J., Municipal-buildings, Anglesea-street, Cork
1901			Oram, Frank, Market-place, Romsey
1890	Trans.		Ormandy, Wm. Reginald, Gamble Institute, St. Helens, Lancs.
1869			‖Orme, Temple A., University College, W.C.; and 213, Uxbridge road, W.
1872			‖Ormerod, Joseph Arderne, M.D., M.R.C.P., The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887			‖Ormiston, Archibald R., Heathland, Uddingston; and 203, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, Australia
1881			Orr, John Bryson, Chestnut-lodge, Widnes, Lancs.
1884	Proc.		Orsman, W. J., jun., Chemical Laboratory, Gathurst, near Wigan
1897	Trans.		Orton, K. J. P., M.A., Ph.D., Lyndhurst, Hayes-road, Bromley, Kent, and St. Bartholomew's Hospital, E.C.
1881	Trans.		O'Shea, L. Trant, B.Sc., c/o Mrs. O'Shea, The Cottage, East Cosham, Hants.
1887			Ostersetzer, Julius, Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1876	Trans.	C. 1882-5 V.P. 95-6	†O'Sullivan, C., F.R.S., 148, High-street, Burton-on-Trent
1883	Trans.		O'Sullivan, James, High Bank, Burton-on-Trent
1899			O'Sullivan, John, 742, Nicola-street, Vancouver City, B.C.
1887			‖O'Sullivan, Patrick T., M.B., B.C.L., 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto C. J. G. L., Chantry House, Great Grimsby
1871	Trans.	C. 1889-94	‖Page, Frederick James Montague, B.Sc., 54, Sutherland-street, Pimlico, S.W.
1896			Page, H. M., Headmaster, Govt. College of Science, Poona, Bombay Presidency
1901			Page, T. H., 40, Wilson-road, Camberwell, S.E.
1898			Pakes, W. C. C., Government Laboratory, Pretoria, S.A.
1884			‖Pallister, J. W., B.Sc., 107, Waverley-road, Bradford
1882			Palmer, Alfred Neobard, Ingle-nook, Bersham-road, Wrexham
1888			Palmer, Henry John, Summerleaze, Yelverton, R.S.O., Devon
1899			Palmer, T. H., "Amalfi," Longueville, Sydney, N.S.W.

† Longstaff Medallist, 1884

Date of Election.			
1879			Palmer, Walter, M.P., The College, Reading, and 50, Grosvenor-square, W.
1899	Trans.		Panting, L.C., M.A., M.D., 45, Lemon-street, Truro
1900			Pardy, Alexander, Pietermaritzburg, Natal, S.A.
1898			Parker, A. J., Wiltshire-villa, Stafford-road, Hounslow
1897			Parker, C. H., Tettenhall, Wolverhampton
1882			Parker, Joseph R., Avondale, 129, Kyverdale-road, Stoke Newington, N.
1894	Trans.		Parker, Matt. A., B.Sc., 13, Hamilton-crescent, Partick, Glasgow
1882			‖Parker, R. H., 35, Clifton-road, Maida Vale, W.
1901			Parkes, Albert E., Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890			Parkes, Thomas, M.A., 2, Gawber-road, Barnsley
1865	Trans.		‖Parkinson, James, F.G.S., Queen's-chambers, Pirie-street Adelaide, South Australia
1893			Parrish, S., 20, Sholebrooke-mount, Leeds
1892			Parry, Ernest John, B.Sc., 208, High-street, Borough, S.E.
1870			Patchett, Isaac, F.I.C., 11, Osborne-terrace, Field-hill, Batley
1894	Trans.		Paterson, David, Lea Bank, Rosslyn, Midlothian, N.B.
1900			Patrick, D. H., A.I.E.E., Bablake School of Science, Coventry
1885	Trans.		Patterson, George, The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, J. W., 14, Mitchell-street, W. Hartlepool, Durham
1870	Trans.		Patterson, T. L., Maybank, Finnart-street, Greenock
1863	Trans.		Pattinson, John, 75, The Side, Newcastle-upon-Tyne
1868	Trans.	{ V.P. 1891-4 }	‖Paul, Dr. B. H., Analytical Laboratory, 13, Fenchurch-street, E.C., and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D., 3, Market-street, Huddersfield
1894			Paulusz, Richard, Assistant City Analyst, Colombo, Ceylon
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Mossley-street, Newcastle-on-Tyne
1893			Payne, George F., M.D., 43½, Whitehall-street, Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley J., 48, Grange-road, S.E.
1901			Peacock, Arthur, B.Sc., Smithies-bridge House, Heckmondwike, Yorks
1900			Pearce, E. V., The Beeches, Hayle, Cornwall
1874			Pearce, William, Chemical Works, Bow Common, E.
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1896	Trans.		Pechmann, F. von, Prof., Tübingen, Germany
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.		‖Pedler, Alexander, Prof., F.R.S., Presidency College, and 31/2, Judge's-court-road, Alipore, Calcutta
1886	Proc.		Pendlebury, William Henry, M.A., 6, Gladstone-terrace, Dover
1870			Penney, M. D., 11, High-street, Hull

Date of Election.			
1895			Pennington, W. H., Field House, Rochdale
1886			Pentecost, Stephen James, Nottingham-road, New Basford, Nottingham
1889	Trans.		Percival, John, M.A., S.E. Agric. Coll., Wye, near Ashford, and Fairview, Wye, Kent
1884	Trans.		Perkin, A. G., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick M., Ph.D., Borough Polytechnic, Borough-road, S.E.
1856	Trans.	C.1861-2 68-9 S.69-83 P. 83-5	†‖Perkin, W. H., LL.D., Ph.D., F.R.S., The Chestnuts, Sudbury, Harrow
1884	Trans.	1891-5	*Perkin, W. H., jun., F.R.S., Fairview, Wilbraham-road, Fallowfield, Manchester
1890	Trans.		‖Perman, Edgar Philip, D.Sc., University College, Cardiff
1888			Perry, George Edward, 6, Norwood-villas, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Moseley-street, Manchester
1881			Philip, Arnold, A.R.S.M., B.Sc., Lond., F.I.C., The Merchant Venturers' Technical School, Bristol
1897			Philip, J. C., B.Sc., Ph.D., Royal College of Science, South Kensington, S.W.
1887			Phillips, A. G., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1889			Phillips, Benjamin, 5, Staunton-road, Poona, India
1897			Phillips, H. E. W., B.A., The Laurels, Eynsham, Oxon.
1882			Phillips, Henry Harcourt, 9, Crawford-avenue, Bolton
1900			Phillpotts, G. Surtees, 82, James-street, Dublin
1897	Trans.		‖Pickard, R. H., D.Sc., Ph.D., Municipal Technical School, Blackburn
1891			Pickering, M. Samuel, B.Sc., Lond., 38, Price-street, Burslem
1878	Trans.	C.1886-7 89-93 1901-	‖Pickering, Spencer Percival Umfreville, M.A., F.R.S., Harpenden, Herts
1890	Trans.		‖Picton, Harold, B.Sc., Ingleside, Clacton-on-Sea
1894			Pike, E. Brooke Grasmere, 515, Romford-road, Forest-gate, E.
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D., Sandhills, Salcombe, Kingsbridge, Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, T. W., 33, Grove-hill-road, Denmark-hill, S.E.
1889			Ping, William, 16, Forest Drive West, Leytonstone, E.
1889			Pingstone, G. Arthur, Bulawayo Public Analyst, P.O. Box 445, Bulawayo, S.A.
1881			Pisani, O. V., Effingham-house, Arundel-street, Strand, W.C.

† Longstaff Medallist, 1888.
* Longstaff Medallist, 1900.

Date of Election.			
1882			Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, F. W., St. Nicholas' Buildings-West, Newcastle-on-Tyne
1899			Pizey, J. H., 11, St. Albans Villas, Highgate-road, N.W.
1893			Platt, Charles, M.D., Ph.D., Hahnemann Med. Coll., Philadelphia, U.S.A.
1860			‖Player, J. H., 16, Prince Arthur-road, Hampstead, N.W.
1899			Plimmer, R. H. Aders, 28, St. John's-wood-road, N.W.
1899			Polkinghorne, B. C., B.Sc., 46, Lynette-avenue, Clapham-common, S.W.
1888			Pollard, F. Ernest, 14, Old Hall-street, Hertford
1898			Pollard, William, B.A., Ph.D., The Museum, Jermyn-street, S.W.
1901			Pollitt, C. J. T., Church-street, Croydon, Sydney, N.S.W.
1896			Pollitt, R. B., c/o The De Beers Explosive Works, Cape Town, South Africa
1897			Pollitt, Samuel, B.Sc., The Polytechnic, South Tottenham, N.
1897	Proc.		Pollock, W. R., Kirkland, Bonhill, Dumbartonshire
1894			‖Pollok, J. Holms, B.Sc., Royal College of Science, Stephen's green, Dublin
189			Pond, James Alexander, Auckland, New Zealand
1899			Ponthieu, Georges, c/o Messrs. Parke, Davis & Co., Detroit, Mich., U.S.A.
1848			Pontifex, Edmund A., M.I.C.E., 72, Cornwall Gardens, S.W.
1862			Pooley, Thomas A., B.Sc., F.I.C., Beverley, Hersham-road, Walton-on-Thames, Surrey
1898	Trans.		Pope, T. H., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	Pope, Wm. Jackson, Prof., 7, Albion-road, Fallowfield, Manchester
1884	Proc.		‖Porter, T. Cunningham, Rev., Eton College, Windsor
1883			Potter, Charles E., c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland S., 2, Museum-hill, Haslemere
1896			Potts, H. W., Euroa, Victoria, Australia
1895			Powell, H. James, 530, Lordship-lane, S.E.
1901			Powell, John, Balliol House, Wentworth-street, E.
1896	Trans.		Power, F. B., Ph.D., 6, King-street, Snow-hill, E.C.
1884			Power, Francis R., The Royal Mint, Melbourne
1876	Trans.		Prescott, Albert B., Prof., M.D., University, Ann Arbor, Michigan, U.S.A.
1882			‖Price, A. F., 524, Sacramento-street, San Francisco, Cal., U.S.A.
1899			Price, R. C., Prof., Virginia Polytechnic Institute, Blacksburg, Virginia, U.S.A.
1901	Trans.		Price, T. Slater, Ph.D., Normandale, Wednesbury
1895	Trans.		Priest, Martin, 4, Dane's-inn, Strand, W.C.
1889			Priestley, Charles W., B.Sc., Vivian Institute, Torquay

Date of Election.			
1870			Pritchard, Prof. William, President Royal Veterinary College, N.W. ; and 5, Regent's Park-road, Gloucester-gate, N.W.
1871	Trans		‖Procter, Henry R., Prof., F.I.C., The Yorkshire College, Leeds, and Rowangarth, Ben Rhydding, via Leeds
1889			Proctor, Charles, 99, Underhill-road, East Dulwich, S.E.
1896			Proude, James, 30, Cromwell-terrace, Halifax
1889			Provis, John, Chesney Mine, Cobar, N.S.W.
1897			Pullar, H. S., Rosebank, Perth, N.B.
1882			‖Pullar, Rufus D., Brahan, Perth
1892	Trans.		Pullinger, William, B.A., 31, Warwick-road, Ealing, W.
1883			Purcell, M. F., 40, Waterloo-road, Dublin
1875	Trans.	C. 1888-92 V.P. 99-1902	Purdie, Thomas, Prof., Ph.D., B.Sc., F.R.S., University, St. Andrews, N.B.
1901			Purvis, J. E., M.A., University Chemical Laboratory, Cambridge
1886			Pyke, L. S. M., M.I.C.E., 44, Kensington Park-gardens, W.
1868			Quibell, Oliver,
1894			Quinn, Gerald G., Meaford Hall Farm, Meaford, Stone, Staffs.
1894			Quinn, J. Cardwell, M.Sc., Hillesdon, Barnstaple
1901			Radcliffe, L. G., 6, Alma-terrace, Old Trafford, Manchester
1897			Ralston, William, B.Sc., Government Chemist, Lagos, West Africa, and 337, Cathcart-road, Glasgow
1892	Trans.		‖Ramage, Hugh, St. John's College, Cambridge
1888			Ramsay, A. Alexander, Sugar Experiment Station, Mackay, Queensland
1873	Trans.	C.1886-8 V.P.92-5 97-1900 F.S.1902-	†‖Ramsay, William, Prof. Ph.D., F.R.S., University College, W.C., and 12, Arundel-gardens, Notting-hill, W.
1901			Ramsden, W. C., 18, Furlough-terrace, Fairview, Clontarf, Dublin
1843			Randall, William B., 52, Archers-road, Southampton
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1900			Rao, M. C. Nanjunda, B.A., M.B., Mylapore, Madras, India
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1880			‖Rawson, Christopher, The Planter's Club, Mozufferpore, Tirhoot, Bengal, India
1884	Trans.		‖Rawson, Sidney George, D.Sc., Technical College, Huddersfield
1898			Ray, J. Armstedt, jun., B.A., 15, Nassau-street, Dublin
1889	Trans.		‖Read, Arthur A., 3, Fitzalan-place, Cardiff
1895			Read, E. J., B.A., 69, Sheen-lane, Mortlake, Surrey
1899	Trans.		Read, H. M., North Lodge, 173, Castlenau, Barnes, S.W.

† Longstaff Medallist, 1897.

Date of Election.			
1900			Readman, James Fraser, 50, Jane-street, Glasgow
1890			Redding, Richard James, 29, Isla-road, Plumstead, S.E.
1874	Trans.		||Reddrop, Joseph, Sound Cottage, Sound, near Nantwich
1892			Redman, Henry Ramsden, 150, Canterbury-road, New Brompton
1866		C. 1891-2	Redwood, Boverton, D.Sc. (Ohio), F.R.S.E., 4, Bishopsgate-street, within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, T. Horne, 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D., 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrst-hof, 8, South Park-hill-road, Croydon, S.E.
1893			Rees, George Percival, Eyton House, St. George's, Salop
1880			||Regester, William, Lawn-lodge. Isleworth, Middlesex
1897			Reid, A. F., Bonshaw, Stewarton, Ayrshire
1893			Reid, Thomas Anderson, 8, Ashton Drive, Hunts Cross, near Liverpool
1881			Reid, Walter Francis, Fieldside, Addlestone, Surrey
1886			Remington, J. Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1897			Remington, J. Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1879	Trans.		Rennie, Edward H., D.Sc., University of Adelaide, S. Australia
1898	Proc.		Renwick, F. F., "Glengall," Woodford-green, Essex
1873	Trans.	V.P. 1881-3, 89-92, 97-1900 P. 1901-	Reynolds, James Emerson, Prof., Sc.D., M.D., F.R.S., Trinity College, Dublin
1898	Trans.		Reynolds, W. Colebrook, B.Sc., Roseleigh, Essex-road, Dartford, Kent
1891			Rhodes, Edward, Oaklands, Overton, Frodsham, Cheshire
1898	Trans.		Rich, E. M., Annaville, Maidyke, Cork
1889			Richards, Duncan T., 29, Osborne-avenue, Westoc-lane, South Shields
1889			||Richards, Edgar, 341, West 88th Street, New York, U.S.A.
1889			||Richards, Percy A. E., F.I.C., 51, Rowan-road, Brook-green, W.
1886			Richards, William, B.Sc., The Clock House, Tooting, S.W.
1898			Richards, William, Flora Cottage, Darlington
1885	Trans.		||Richardson, Arthur, The Central Hindoo College, Benares N.W.P., India
1888	Trans.		||Richardson, Clifford, Director, New York Testing Laboratory, Long Island City, New York, U.S.A.
1883			Richardson, F. W., Broad Oak, Oak-avenue, Bradford
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert N. B., 10, Friar-lane, Leicester
1866			Richardson, Joseph, 40, Warwick-road, Chorlton-cum-Hardy, Manchester

Date of Election.			
1892			Richardson, Reginald E. S., 10, Friar-lane, Leicester
1887	Trans.		Richmond, H. Droop, Fair Holm, Grimwood-road, Twickenham
1845			||Rickard, W. T., 136, Maygrove-road, West Hampstead, N.W.
1894			Riddick, D. G., Stores Department, G.E.R., Stratford, E.
1882	Trans.		||Rideal, Samuel, D.Sc., F.I.C., 28, Victoria-street, Westminster, S.W.
1873			Rider, Alonzo John, 4, Haddington-road, Stoke, Devonport
1895			Ridge, W. T. B., 2, Ashwood-terrace, Longton, Staffs.
1882	Trans.		Ridsdale, C. H., Wilton Lodge, Southfield-road, Middlesbrough
1888			Rigby, John S., 26, Bagot-street, Wavertree, Liverpool, and West Thurrock, Essex
1898			Rigg, Gilbert, Tudor Villa, Bryn-road, Swansea
1851	Trans.	C. 1878-9	Riley, Edward, 14A, Finsbury-square, E.C.
1900			Riley, W. A., Brunswick Lodge, New Market-road, Norwich
1893			Rintoul, William, Royal Gunpowder Factory, Waltham Abbey
1893			Ritchie, George, 9, Gordon-terrace, Shettleston, Glasgow
1893			Robbins, James H., B.Sc., 4, Selborne-road, Ilford
1872			Robbins, John, 57, Warrington-crescent, Maida-vale, W.
1897			Roberts, E. H., 81, Cicada-road, Wandsworth, S.W.
1883			||Roberts, Frederick G. Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899			Roberts, James, jun., 43, Great Western-road, Glasgow
1876			Roberts, Martin Fenn, General Post Office, E.C., and Mabshill, Epsom.
1889			Roberts, R. Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894			Roberts, Thos. John, Cowley Villa, 33, Serpentine-road, Liscard, Liverpool
1880			Roberts, W. Brittain, Wilderspool House, Warrington, Lancashire
1866	Trans.	C. 1879-81 V.P. 95-8	Roberts-Austen, Sir William Chandler, K.C.B., F.R.S., Royal Mint, E.
1894			Robertson, A. B., Struan, Giffnock, by Glasgow
1887			Robertson, George, London Hospital, E., and Madeira-villa, Woodford Green, Essex
1890	Proc.		||Robertson, George Henry,
1901			Robertson, William, 41, Rosenau-road, Battersea-park, S.W.
1889			Robins, Harry H., Messrs. Southwell and Co., Dockhead, S.E.
1881			Robinson, G. Carr, Hull Chemical Works, Cumberland-st., Hull
1882	Trans.		||Robinson, Henry H., M.A., 98, Finborough-rd., West Brompton, S.W.
1896			Robinson, H. F., B.Sc., Sparthfield, 342, Droylsden-road, Newton-heath, Manchester
1895			Robinson, H. Lewin, c/o Messrs. Vickers, Sons & Maxim, Ltd., Erith Works, Erith

Date of Election.			
1866			Robinson, John, 6, Hampstead-hill Mansions, Hampstead, N.W.
1892	Trans.		Robson, James, Andersonian-buildings, 204, George-st., Glasgow
1898			Rofe, H. J., M.A., 8, Victoria-street, Westminster, S.W.
1883			Rogers, Arthur W., Tadcaster Tower Brewery Co., Tadcaster
1884			Rogers, Francis M., 21, Burma-road, Stoke Newington, N.
1894			Rolfe, John F., 18, Victor-street, Clayton-le-Moors, Lancashire
1886			Roose, Robson, M.D., 45, Hill-street, Berkeley-square, W.
1855	Trans.	C.1860-3 71-2 V.P.73-4 77-80 P. 80-2	Roscoe, Sir H. E., LL.D., D.C.L., Ph.D., F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897 8	‖Rose, T. K., D.Sc., 9, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D., 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, 1, Glengall-road, Old Kent-road, S.E.
1881			Ross, Rev. Henry, LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, Raymond, Public Analyst, Burnley
1902			Ross, William Charles, 27, Pitt-street, Edinburgh
1891	Proc.		Rossiter, Edmund Charles, Bloxcidge House, Langley, Birmingham
1899			Rossiter, Sydney, 19, Ranelagh-road, South Tottenham, N.
1896			Rostron, Harold, B.Sc., 202, Tonge Moor-road, Bolton
1892			Rothwell, C. F. Seymour, 15, Skerton-road, Old Trafford, Manchester
1895			Round, W., 100, Bagot-street, Birmingham
1899			Roundell, C. Foulis, Lieut. Coldstream Guards, Guard's Club, Pall Mall, S.W.
1894			Rowntree, Walter Smithson, B.Sc., F.L.S., Leighton-park, Reading
1900			Roy, M. Goolab, Chintadirpetah, Madras, India
1901			Royle, C. L., Nellikuppam, S. Arcot, India
1862			‖Royle, Thomas, 329, Upton-lane, Forest Gate, E.
1872	Trans.		Ruffle, John, Musley, Ware, Herts.
1895			Rugginz, W. A., "Strathmore," 14, Empress-avenue, Cranford Park, Ilford
1889	Trans.		Ruheman, Siegfried, Ph.D., M.A., Gonville and Caius College, Cambridge
1883			Rumble, Charles, 9, Sangora-road, New Wandsworth, S.W.
1890			‖Russell, Edward, 35, Southeby-road, Highbury Park, N.
1899	Trans.		Russell, E. J., B.Sc., S.E. Agricultural College, Wye, Kent
1901			Russell, J. B., B.Sc., 35B, Padiham-road, Burnley
1896			Russell, William, c/o The Gold and Silver Extraction Co., Limited, 208-210, McPhee Buildings, Denver, Colorado, U.S.A.
1899			Russell, William, 52, Cobham-street, Gravesend

Date of Election.			
1851	Trans.	C. 1863-7 70-1 V.P. 72 S. 73-5 T. 75-89 P. 89-91	‖Russell, W. J., Ph.D., F.R.S., 34, Upper Hamilton-terrace, St. John's-wood, N.W.
1897			Rutter, Alfred, School of Mines, Broken-hill, N.S.W.
1896			Rutter, T. F., B.Sc., The Municipal Technical School, Birmingham
1894			Ryce, George, B.A., Kildare County Council, Secretary's Office, Naas, Kildare
1901			Ryffel, J. Henry, 10, Onslow-gardens, Highgate, N.
1888			Sach, A. J., Technical College, Goulburn, N.S.W.
1868			Sadler, S. A., Cleveland Chemical Works, Middlesbrough
1882			Sadtler, Samuel P., Ph.D., 145, North 10th-street, and 1042, Drexel-buildings, Philadelphia, U.S.A.
1896			Sage, C. E., 2, Charterhouse-street, E.C.
1898			St. John, Harry, Thornfield, Sunderland
1879	Trans.		‖Sakurai, Joji Science College, Imperial University, Tokyo, Japan
1880			Salamon, Alfred Gordon, 27, Holland-park, W.
1876			‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and Berkeley Chambers, 13, Bruton-street, Hyde-park, W.
1896			Salt, A. P., Rosecroft, St. James-road, Sutton, Surrey
1863			‖Salt, Henry, M.D., C.M., F.R.G.S., Inglewood, Great Malvern
1871			‖Salter, Mortyn John, 65, Park-road, Crouch End, N.
1859			‖Salter, Thomas W., 15, Belle Vue, West-hill, Hastings
1882			Samuel, W. Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.
1898			Sand, H. J. S., Ph.D., University College, Nottingham
1870			‖Sandberg, C. P., Palace-chambers, 9, Bridge-street, Westminster, S.W.
1899			Sandercock, Thos. J. Buckler, Sidcup College, Sidcup, Kent
1900			Sanders, J. McConnell, English College, 619, Oijor Carboyal, Tacubaya, Mexico, F.D.
1888			Sanderson, John, 4, Lancaster-road, Belsize-park, N.W.
1901			Sandford, Allan, Restituo Albergo, Rio Marina, Isola, D. Elba, Italy
1900			Sandford, J. Wallace, c/o Messrs. A. W. Sandford and Co., Grenfell-street, Adelaide, South Australia
1901			Sandford, Thomas, 2, Market-place, Ulverston
1882			Sanford, P. Gerald, Laboratory, 20, Cullum-street, E.C.
1890			Saniter, Ernest Henry, 51, Grange-road, West Middlesbrough
1891			Sanyal, Abhayacharan, M.A., Professor of Physical Science, Queen's College, Benares, N.W.P., India
1892			Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900			Sargeant, F. Pilkington, Springfield-place, Leeds

Date of Election.			
1886			Saunders, Prof. William, Experimental Farm, Ottawa, Ontario, Canada
1896			Saville, A. E., 89, Lancaster-avenue, Fennel-street, Manchester
1898			Sayer, H. C., 25, Summerhill-road, Dartford
1890			Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885			Scammell, Luther R., 42–4, King William-street, Adelaide, South Australia
1877			Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897			Scargill, L. W. K., B.A., 4, Lingdale-road, Birkenhead.
1893	Trans.		Schidrowitz, Philip, Ph.D., 57, Chancery-lane, W.C.
1888			‖Schieffelin, William Jay, Ph.D., 840, Southern-boul., New York, U.S.A.
1892			‖Schofield, James Alexander, University of Sydney, New South Wales
1899	Trans.		Schryver, S. B., D.Sc., Ph.D., Effingham-house, Arundel-street, Strand, W.C.
1842	Trans.	C. 1847-50, 59-62 V.P. '82-85	Schunck, Edward, Ph.D., F.R.S., Oaklands, Kersal, Manchester
1899			Schweich, E. M., 20, Hyde-park-square, W.
1896			Scotland, P. B., Airdrie Academy, Airdrie, N.B.
1879	Trans.	C. 1897-9 S. 1899-	‖Scott, Alexander, M.A., D.Sc., F.R.S., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, G. C., Bolckow, Vaughan and Co., Ltd., Eston Grange Farm, Grangetown, R.S.O.
1887			Scrutton, W., J.C., F.I.C., The Elkhart Mine, Chloride, Mohave Co., Arizona, U.S.A.
1883	Proc.		Scudder, Frank, 44, Mosley-street, Manchester
1896			Seabrooke, H. C., "Black Ash," Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup
1890			Seaton, Edward C., M.D., The Limes, 56, North Side, Clapham Common, S.W.
1899			Seligman, Richard, 1, Bolley-strasse, Zürich, IV.
1892	Trans.		Sell, William James, M.A., F.R.S., Univ. Chem. Laboratory, Pembroke-street, Cambridge
1875			Sellon, J. Scudamore, 78, Hatton-garden, E.C.
1875	Trans.		‖Senier, Alfred, Prof., M.D., Ph.D., Queen's College, and Gurthard, Galway
1887			Senier, Harold, Braybrook Lodge, Harrow
1899			Senior, George, B.A., Brynaeron, St. George's-road, Abergele, North Wales

Date of Election.			
1893			Sessions, Wilfred, B.Sc., Dalton House, Kendal
1896			Severn, W. D., 9, Earl's-court-square, S.W.
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.
1874			‖Sexton, A. Humboldt, F.I.C., F.R.S.E., Professor of Metallurgy, Metallurgical Department, Andersonian-buildings, 204, George-street, Glasgow
1895			Seyler, C. A., B.Sc., 31, Windsor-terrace, Swansea
1880			Shadwell, J. E. L., 2 Woodland Place, Bath
1893			‖Shapley, Frederick, c/o Messrs. Shapley and Co., 246, Front-street, New York
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, Shirely Manor, Wyke, near Bradford
1895			Sharrott, T. C., Bovey Tracey School, Devon
1892			Shaw, G. Arthur, 45, St. Petersgate, Stockport
1895	Trans.		Shaw, G. E., 22, Baythorne-street, Bow, E.
1887			Sheard, John T., Birley Mount-villas, Wadsley-bridge, near Sheffield
1889			Shegog, Thomas Alexander, 39, St. Mary's-road, Dublin
1899			Shelbourn, E. T., F.I.C., 40, Craven-street, Strand, W.C.
1899			Shelton, A. J., c/o The Schultze Gunpowder Co., Ltd., Eyeworth Lodge, Lyndhurst, Hants
1876	Trans.	C. 1889-7	‖Shenstone, W. A., F.R.S., Clifton College, Bristol
1897			Shenton, J. P., Alresford, 29, Claude-road, Chorlton-cum-Hardy, nr. Manchester
1899	Trans.		Shepheard, W. F. J., 12, Bridge-street-row, Chester
1874			‖Shepherd, H. H. B., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899			Shepherd, J. W., B.Sc., 48, Ovington-street, S.W.
1901			Sheppard, S. E., Ravensmere, Bromley-road, Catford, S.E.
1901			Shepperson, William, Abbey-court, Abbey-road, N.W.
1898			Sheridan, M. J., 20, Heathland-road, Stoke Newington, N.
1901			Sherratt, C. E. S., 24, Argyll-road, Normacott, Staffs.
1901			Sherwood, E. C., St. Peter's College, Westminster
1891	Trans.		‖Shields, John, Ph.D., D.Sc., 22, Upper George-street, Bryanston-square, W.
1896			Shimomura, Kotaro, Prof., Osaka Seimi Works, Co., Kawagi-shicho, Nishiku, Osaka, Japan
1894			Shorthouse, H. S., 47, Pershore-road, Birmingham
1886			Shutt, Frank T., M.A., Experimental Farm, Ottawa, Canada
1890			Shuttlewood, W. Brewin, 8, Clifton-road, Crouch End, N.
1894			Shuttleworth, E. B., Prof., 220, Sherborne-street, Toronto, Canada
1859			Sibson, Alfred, 23, St. Mary Axe, E.C.

Date of Election		
1889		Sibson, Alfred Edward, 1, Maple-villas, Palmerston-road, Buckhurst Hill, Essex
1901		Sichel, G. T. S., F.R.C.S. (Eng.), L.R.C.P. (Lond.), R. N. Hospital, Haslar, Gosport
1902		Sidgwick, Nevil Vincent, M.A., D.Sc., Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D., Royal Arsenal, Woolwich
1886		Silvester, Harry, 78, Holyhead-road, Handsworth, Birmingham
1885		Sim, James, Connage Rathview, by Buckie, viâ Aberdeen
1899		Simmonds, Charles, B.Sc., Belle Vue, Thurlow Hill, West Dulwich, S.E.
1889		Simmonds, Henry, Engineer's Office, Gas Works, and Elton View House, Bury, Lancashire
1887		||Simmons, L. Owen, 360, Coldharbour-lane, Brixton, S.W.
1895		Simons, A. J., c/o M. Simons, Esq., 31, Little Britain, E.C.
1896		Simpson, A. M., Elmcroft, 26, Nelgarde-road, Catford, S.E.
1897		Simpson, E. S., B.E., Geological Survey Office, 395, St. George's-terrace, Perth, W.A.
1886		||Simpson, William Selby, Halcyon House, Private-road, Enfield, N.
1889		Singer, Ignatius, Petone, New Zealand.
1902		Sinnatt, Frank S., Glenside, Church-lane, Moston, Manchester
1896		||Sircar, Amrita Lal, 51, Sankaritola, Calcutta
1888	Trans.	Skinner, Sidney, M.A., The Cavendish Laboratory, Cambridge
1899	Trans.	Skirrow, F. W., Rose Bank, Bentham R.S.O., Yorkshire
1892		Skurray, Thomas, United Breweries, Abingdon, Berkshire
1879		Slater, Charles, M.A., M.B., M.R.C.S., 81, St. Ermin's-mansions, Westminster
1880	Trans.	||Slater, Harold H., Havelock-villa, St. James's-road, Gravesend
1878		||Slatter, George W., F.I.C., Carlton-terrace, Nab Wood, Shipley, Yorkshire
1895		Slocum, F. L., 401, outh Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		||Smetham, Alfred, Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1900		Smiddy, Timothy A., 13 Leitrim-street, Cork
1898	Trans.	Smiles, Samuel, B.Sc., embroke-Gardens, Kensington, W.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	||Smith, Alexander, Ph.D., B.Sc., University of Chicago, Chicago, U.S.A.
1888		Smith, Angus, 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, B. Jordan, 42, King's-road, Reading, and 1, Leyton-avenue, Mansfield, Notts.
1894		Smith, Claude, Barngarth, Cartmel, Carnforth
1884	Trans.	||Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.

Date of Election.			
1894	Trans.		Smith, Ernest A., Assay Office, Leopold-street, Sheffield.
1900			Smith, E. Shrapnell, 35, Botanic-road, Wavertree Park, Liverpool
1892			‖Smith, Fred., P.O. Box 1324, Johannesburg, Transvaal, S. Africa
1874			Smith, George, Nobel's Explosives Co., Polmont Station, Scotland
1896			Smith, G. E. Scott, 67, Surrey-street, Sheffield
1892			‖Smith, George P. Darnell, The Merchant Venturers' Technical College, Bristol
1901			Smith, H. Ewing, 22, City-road, E.C.
1896	Trans.		Smith, H. G., The Technological Museum, Sydney, N.S.W.
1901			Smith, H. Metcalfe, 31, Upper Tulse-hill, Brixton
1900			‖Smith, H. Proctor, 146, Harrington-road, Workington, Cumberland
1878			Smith, H. R., 1, Aubert-park, Highbury, N.
1890			Smith, Harry Wood, B.Sc., The British Cyanides Co., Ltd., Oldbury, Birmingham
1901			Smith, James, 30, Milner-road, Aigburth, Liverpool
1892			Smith, John Meadows,
1879			Smith, J. W., Massachusetts Institute of Technology, Boston, Mass., U.S.A.
1901			Smith, Norman, B.Sc., Owens College, Manchester.
1897			Smith, R. F. Wood, 89, Bartholomew Close, E.C.
1891			Smith, R. Greig, M.Sc., Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1902			Smith, Robert S. Blake, B.Sc., 93, Upper Richmond-road, Putney, S.W.
1888			Smith, Sam, Hillsboro', Goddard-avenue, Old Swindon
1898			Smith, T. de, B.A., 152, Evering-road, Stoke Newington, N.
1876			‖Smith, W. A., M.A., M.B. Oxon, M.R.C.S. Eng., Newport, Essex
1866	Trans.		Smith, Watson, 34, Upper Park-road, Haverstock Hill, N.W.
1883	Tran	C. 1896-1903	Smithells, Arthur, Prof. B.Sc., F.R.S., The Yorkshire College, Leeds
1873			‖Smyth, John, M.A., Milltown, Bantridge, Ireland
1887	T		‖Snape, Henry Lloyd, Prof., D.Sc., Ph.D., Balholm, Lathom-road, Southport
1899			Soddy, Frederick, Chemistry and Mining Building, McGill University, Montreal, Canada
1896	Trans.		Sodeau, W. H., B.Sc., 25, Shore-road, South Hackney, N.E.
1887			Sohn, Charles E., F.I.C., 2, Harpur-street, Bedford-row, W.C.
1891			Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1898			Somerville, Henry, B.Sc., 33, Vincent-square, S.W.
1874	Trans.		Sonstadt, Edward, Church Field, Cheshunt, Herts
1893			Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875			Southall, Alfred, Garrick House, Richmond Hill, Edgbaston

Date of Election.			
1897			Southerden, Frank, 75, Barry-road, Dulwich, S.E.
1897			Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902			Southworth, William, County Council Farm, Hutton, Preston, Lancs.
1883			Soward, Alfred W., 28, Therapia-road, Honor Oak, S.E.
1892			Spackman, Charles, Rosehaugh, Clitheroe, Lancashire
1901			Spence, J. D., 2, Hawk Hill-place, Perth-road, Dundee
1883			‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1886			Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887			Spencer, W. Shelley, Lyndene, Darley, Farnworth, near Bolton
1894			Spenzer, John George, Prof., M.D., Ph.D., Ohio Wesleyan University, 261, Amesbury-avenue, Cleveland, Ohio, U.S.A.
1859	Trans.		‖Spiller, John, 2, St. Mary's-road, Canonbury, N.
1863			‖Spiller, William, Atlas Dye Works, Hackney-wick, E.
1885			Spilsbury, James, Mayfield, Mayfield-road, Moseley, Birmingham
1885			‖Spottiswoode, W. Hugh, Balliol College, Oxford ; and 6, Middle New-street, E.C.
1864	Trans.	C. 1872-5	Sprengel, Hermann Johann Philipp, Ph.D. (Heidelb.) F.R.S., Royal Prussian Professor (titular), Savile Club, 107, Piccadilly, W.
1895			Squance, T. C., M.D., M.S., L.S.Sc., F.R.M.S., F.R.M.St. S., 15, Grange-crescent, Sunderland
1882			‖Squire, P. Wyatt, 413, Oxford-street, W.
1858	Trans.		Squire, W. Stevens, Ph.D., Clarendon House, St. John's Wood-park, N.W.
1892			Squires, Alfred James, "Greenbank," Coroner's-lane, Farnworth, Widnes, Lancs.
1877			Stacey, Henry George, 300, High Holborn, W.C.
1897			Stainer, W. J., B.A., Charlesville, Beaconsfield-road, Widnes, Lancs.
1899			Stainer, W. J., 103, Cheriton-road, Folkstone
1879	Trans.		‖Stallard, George, M.A., Horton-crescent, Rugby
1887			Stanger, W. Harry, Chemical Laboratory, Broadway, Westminster
1887			‖Stansell, Lionell W., 7, Albion-place, Maidstone, Kent
1895			‖Stansfield, Alfred, D.Sc., McGill University, Montreal, Canada
1899			Stansfield, Samuel, B.Sc., Hollins-crescent, Hebden Bridge, Manchester
1900	Trans.		Stapleton, Prof. H. E., B.A., Presidency College, Calcutta, India
1870			Starey, Arthur J., Blythwood, Muswell-avenue, Muswell-hill, N.
1870	Trans.		‖Stark, J. Fleming, 9, Allfarthing-lane, Wandsworth, S.W.
1902			Stead, Francis Bernard, Clifton College, Bristol
1896			Stead, J. C., Mitre Chemical Works, Cordova-road, Bow, E.
1882	Trans.		Stead, J. E., 11, Queen's-terrace, Middlesbrough

Date of Election.			
1897			Steel, F. W., c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Victoria
1885			Steel, Robert Elliot, County School, Northampton
1894			Steel, Robert W., St. Ninians, Meiklerigg, Paisley
1890			Steel, Thomas, c/o Colonial Sugar Refining Co., O'Connell-street, Sydney, N.S.W.
1900	Trans.		Steele, Bertram D., 6, Rosebery-gardens, Crouch End, N.
1884			Steele, Robert, 63, Balham Park-road, Wandsworth Common, S.W.
1898			Steinhart, O. J., Ph.D., Blackfriars Testing Works, 91, Blackfriars-road, S.E.
1901			Stell, S. F., 25, Henry-street, Keighley
1892	Trans.		‖Stenhouse, James, View Park Gardens, Bonnyrigg, Midlothian, N.B.
1884			Stenhouse, Thomas, Townhead, Rochdale
1895	Trans.		Stephens, F. R., c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880			‖Stephens, Henry Charles, M.P., 4, Carlton-gardens, S.W.
1897			Stephens, M. E., 4, Carlton-gardens, S.W.
1895			Stephenson, Herbert F., 14, Gap Road, Wimbledon, S.W.
1902			Stephenson, Robert, junr., B.A., Burwell, Cambridgeshire
1885			Stephenson, Stephen, 98, Kensington, Liverpool
1891	Trans.		Stephenson, Thomas, c/o H. S. King & Co., 65, Cornhill, E.C.
1888	Trans.		Stern, Arthur Landauer, D.Sc., F.I.C., Southbank, Stapenhill, Burton-on-Trent
1898			Steuart, Basil, Parkisimo P.O., Manitoba, Canada
1881			Steuart, Daniel Rankin, Osborne Cottage, Broxburn, Linlithgowshire
1896			Steuart, D. Stuart Spens, B.Sc., The Royal Societies' Club, St. James's-street, S.W.
1897	Trans.		Stevens, H. P., B.A., The Firs, Guildford-road, Ash, Surrey
1899			Stevenson, Arnold, B.A., 4, Porchester-gardens, W.
1864		C.1872-4 86-7,94-7 V.P. 1900-	Stevenson, Thomas, M.D., Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, W. F. K., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcestershire
1887			Stocks, Herbert B., Lynwood, Neston, Cheshire
1894	Trans.		Stoddart, Frederick Wallis, Grafton Lodge, Sneyd Park, Bristol
1879			‖Stokes, A. W., Vestry Hall, Paddington, W.
1873			‖Stone, Edward Daniel, Rose Lea, Alderley Edge, Cheshire
1890			Stone, Frederick Richard M., c/o Messrs. Groves & Whitnall, Regent-road Brewery, Salford

Date of Election.		
1895		Stone, George, McCracken's City Brewery, Melbourne
1875		‖Stone, J. Harris, M.A., F.L.S., Barrister-at-Law, 4, Temple, E.C.
1879		‖Stone, William, M.A. (Cantab), F.L.S., Oxford and Cambridge, Garrick, and Union Clubs, and F 2, The Albany, Piccadilly, W.
1891		‖Storey, James Ashburner, B.Sc., Igalkanda Estate, Elpitiya, Ceylon ; and Underfell, Lancaster
1900		Storr, B. V., B.Sc., 203, Grange-road, Ilford, Essex
1887		‖Strangman, J. Pim, 38, Rue Desbordes-Valmore, Paris-Passy
1900		Strong, A. H., 63, Herne-hill-road, Camberwell, S.E.
1885	Trans.	‖Stuart, Charles M., M.A., St. Dunstan's College, Catford, S.E.
1897		Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1893		Styles, R. Curling, Knockhall, Greenhithe, Kent
1890	Trans.	‖Sudborough, J. Joseph, Ph.D., D.Sc. University College of Wales, Aberystwyth
1878	Trans.	‖Suguira, Shigetake, c/o Tokio Chemical Society, 50, Kasugacho, Koishikawa, Tokio, Japan
1897		Sumner, Leonard, B.Sc., Butt Hill, Prestwich, near Manchester
1887		‖Sutherland, D. A., F.I.C., 13, Victoria-street, Westminster, S.W.
1884		Sutton, C. W., 19, Henley-road, Ipswich
1860		Sutton, Francis, Laboratory, Bank Plain, Norwich
1886		‖Sutton, F. Napier, 6, Grosvenor-gardens, Willesden Green, N.W.
1902		Swain, James, 17, Winsham-street, West-side, Clapham Common, S.W.
1875		Swan, Joseph Wilson, M.A., F.R.S., 58, Holland-park, W.
1889		Swan, Robert M. W., 15, Walmer-crescent, Glasgow
1894		‖Swinburne, James, 82, Victoria-street, S.W.
1891		Sykes, M. Carrington, L.P.H. Lond., L.R.C.P. Lond., M.R.C.S. Eng., L.S.A. Lond., Sykeshurst, Barnsley, Yorks.
1891		Symes, K. Edward, 95, Lodge-road, The Avenue, Southampton
1880		Symons, Brenton, 5, Kew Gardens-road, S.W.
1874	Trans.	‖Symons, William H., M.D. (Brux.), D.P.H. (Oxon.), M.R.C.S. Eng., F.I.C., Medical Officer of Health's Dept., Guildhall, Bath
1899	Trans.	Szarvasy, E. C., Ph.D., Muegyetem VIII, Budapest, Hungary
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokio, Japan
1887	Trans.	‖Takamine, Jokichi, 61, West 108th-street, New York, U.S.A.
1901		Talbot, John, B.A., B.Sc., Tunstall House, Harrow
1901		Tankard, A. R., 67, Surrey-street, Sheffield
1894		Tanner, Alf. E., Westminster Hospital, S.W.
1901		Tatam, G. W. G., Mercer's Hall, Cheapside, E.C.
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D., York Buildings, 14, Dale-street, Liverpool
1884		‖Tate, Walter, The Woodlands, Twerton-on-Avon, Bath

Date of Election.		
1890		Tate, William, Prof., Civil Engineering College, Sibpur, Calcutta
1867		Tatlock, Robert R., Novara, Stirling
1897		Taverner, William, B.Sc., Burnden, Hamilton-road, Burton-on-Trent
1894		Taylor, Albert, 413, Buxton-road, Stockport
1882		Taylor, G. Midgley, 27, Great George-street, Westminster, S.W.
1894		Taylor, Herbert J., 9, Portland-villas, Bath-street, Dewsbury
1880		‖Taylor, James, B.Sc., Government Metallurgical Works, Clyde, New South Wales
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John G., 16, Trinity-street, Stockton-on-Tees
1874	Trans.	Taylor, R. L., 37, Mayfield-road, Whalley Range, Manchester
1901		Taylor, W. H., A.I.C., 4A, Durlston-road, Northwold-road, Upper Clapton, N.E.
1888		Taylor, William, China Sugar Refining Co., East Point, Hong Kong
1878		‖Tcherniac, Joseph, Ph.D., Thalstrasse 1, Freiburg, Briesgau, Germany
1879	Trans.	‖Teed, Frank L., D.Sc., 9, Mincing-lane, E.C.
1901		Templeman, W. H., 67, Park-street, Spring Bank, Hull
1894		‖Terry, Edwin, 374, Brixton-road, S.W.
1881		Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893		Thackrah, James R., M.A., Ph.D., Technical Schools, Tavistock-road, Plymouth
1895		Theodosius, A. F., B.A., University College, Oxford
1899		Thiersch, H. A., Safety Explosives Co., Ltd., Herodsfoot, St. Keyn R.S.O., Cornwall
1901		Thomas, A. E., B.Sc., F.I.C., Science and Technical Schools, Barrington-street, Tiverton, Devon
1859		‖Thomas, Andrew, Cavendish-street, Semaphore, South Australia
1871		‖Thomas, Charles, J.P., Stoke Bishop, nr. Bristol
1874		Thomas, Harry E., Rockleaze Point, Clifton, Bristol
1875	Trans.	‖Thomas, Joseph William, 2, Hampstead Hill Mansions, N.W.
1877		‖Thompson, Beeby, 67, Victoria-road, Northampton
1886	Trans.	‖Thompson, Claude M., Prof., D.Sc., M.A., University College, and 38, Park-place, Cardiff
1894		Thompson, Edward Cumming, 40, Glenluce-road, Westcombe Park, S.E.
1893		Thompson, Frank Ernest, 51, Lichfield-road, Walsall
1893		Thompson, George R., The Laboratory, 69, Dock-street, Newport, Mon.
1897		Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1886		Thompson, W. Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1885	Trans.	Thomson, Andrew, D.Sc., Ardenlea, Pitcullen, Perth

Date of Election.			
1876			Thomson, George Carruthers, 53, Bedford-road, Rockferry, Birkenhead
1872	Trans.	C. 1880-2 S 83-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., LL.D., F.R.S., King's College, W.C.; and 85, Addison-road, Kensington, W.
1899			Thomson, R. T., 156, Bath-street, Glasgow
1872			Thomson, William, Royal Institution Laboratory, Manchester
1895			Thomson, W. T., Oxford-villas, Waltham Abbey
1891			Thonger, C. G. Freer, M.R.A.C., Colonial College, Hollesley Bay, Suffolk
1882	Trans.		Thorne, Leonard T., Ph.D., 8, Dynevor-road, Richmond
1900			Thornton, A. L., B.Sc., 2, Park-street, Bolton
1895			Thornton, Arthur, M.A., The Grammar School, Bridlington
1891			Thorp, Walter, B.Sc., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph D., Owens College, Manchester
1871	Trans.	C. 1879-82 V.P. 84-6 T. 89-99 P. 1899-1901	†Thorpe, T. E., Ph.D. (Heid.), B.Sc. (Vict.), Sc.D. (Dubl.), LL.D. (Glas.), F.R.S., Government Laboratory, Clements Inn-passage, W.C.
1899			Threlfall, Richard, Prof., F.R.S., 30, George-road, Edgbaston, Birmingham
1894			Thudichum, George Dupré, 2, Salcombe-villas, Kingston-road, Merton Park, Wimbledon
1880			Thwaite, B. H., 29, Great George-street, Westminster, S.W.
1895			Tibbals, W. I., 93, Cass-street, Detroit, Mich., U.S.A.
1863	Trans.		Tichborne, C. R. C., Ph.D., 15, North Great George-street, Dublin
1897	Trans.		Tickle, Thomas, Public Analyst's Laboratory, Exeter
1865	Trans.	C. 1878-80 V.P. 85-7 91-4, 96-9 T. 1899-	‖Tilden, William A. Prof., D.Sc. (Lond.), Sc.D. (Dubl.), F.R.S., Royal College of Science, South Kensington; and The Oaks, Northwood, Middlesex
1900			Tilley, J. W., 2, Stockwell-crescent, S.W.
1889	Trans.		‖Tingle, J. Bishop, Prof., Ph.D., Illinois College, Jacksonville, Ill., U.S.A.
1898			Tisdale, C. W. Walker, The College, Reading
891			Tocher, James Fowler, A.I.C., 1, Chapel-street, Peterhead
900			Tomlins, G. E., 44, Loampit Hill, Lewisham, S.E.
884	Trans.		‖Tompson, Frederick William, The Bower, Limpsfield, Surrey
877			‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
855	Trans.		‖Tookey, Charles, Museum of Practical Geology, Jermyn-street, S.W., and The Portland Hotel, Great Portland-street, W.
893			‖Towers, John William, Victoria-road, Widnes
888			Townsend, Charles F., West View, Swanley-junction, Kent.
901			Tozer, H. A., B.A., 113, Stepney Green, E.

† Longstaff Medallist, 1881.

Date of Election.		
1887		‖Traphagen, Dr. Frank W., Agricultural Experiment Station, Bozeman, Montana, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris W., D.Sc., 39, Lithos-road, N.W.
1895		Treharne, F. G., Wrangbrook, Llanishen, near Cardiff
1894		Trench, George, Pilton Villa, Herne Bay, Kent
1888		‖Trewby, Herbert, 62, St. John Street, E.C.
1881		‖Trigger, Oliver, Chemical Dept., Royal Arsenal, Woolwich, S.E.
1897		Tripp, E. H., Ph.D., The Grammar School, Swansea
1873		‖Truman, Edgar, M.D., 9, Watcombe Circus, Carrington, Nottingham
1898	Proc.	Tucker, S. A., Ph.D., Columbia University, New York, U.S.A.
1889		Tucker, Willis G., M.D., Medical College, Albany, New York, U.S.A.
1896		Tuckett, J. E. S., M.A., Cantab, Marlborough College, Wilts.
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancashire
1897	Trans.	Turnbull, Andrew, Ph.D., The Yorkshire College, Leeds
1886		Turner, Arthur, L.D.S.Ed., The Limes, Aylesbury
1896		Turner, B. B., B.Sc., University of Missouri, Columbia, U.S.A.
1897		Turner, B. W., 14, Castlereagh-street, Sydney, N.S.W.
1888	Trans.	Turner, Charles, 225A, Oxford-street Manchester
1897		Turner, J. S., 20, Bury-street, Bloomsbury, W.C.
1902		Turner, Lyon V., Crescent Lodge, St. John's, S.E.
1883	Trans.	‖Turner, Thomas, Prof., A.R.S.M., F.I.C., The University, Birmingham
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robt., F.R.G.S., Albion House, The Marina, Deal
1888	Trans.	Tutton, Alfred E., F.R.S., 17, Bardwell-road, Oxford
1879		Tweedie, G. R., Etleigh, Herschel Park, Slough
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1899		Tyler, E. A., B.A., Framlingham College, Suffolk
1876		Typke, P. G. W., Lawn House, New Malden, Surrey
1876		Tyrer, Thomas, Stirling Chemical Works, Abbey-lane, Stratford, E.
1885		Tyson, Thomas B., 22, Croppin's-park-terrace, Mutley, Plymouth
1876		‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffordshire
1865		Umney, Charles, 50, Southwark-street, S.E.
1893	Trans.	Umney, John C., 50, Southwark-street, London, S.E.
1889		‖Underhill, Thomas J., 73, Pepys-road, New Cross, S.E.
1897		‖Unwalla, R. N., Medical Dept., Bhaunagar, Kathiawâr, India
1882		‖Vacher, Francis,
1890		Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales

Date of Election.			
1901			Varley, Harold F. F., École de l'Esterel Mandelein, près Cannes, (A.M.), France
1883			Vasey, S. A., Beechcroft, Burnt Ash-lane, Bromley, Kent
1882			Vasey, Thomas E., P.O. Box 1149, Montreal, Canada
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor H., M.A., F.R.S., 20, Bradmore-road, and University Museum, Oxford
1891			Velling, F. W. De, B.A., High Grade Board School, The Boulevard, Hull
1881			Venable, Frank P., Ph.D., Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas J. M., Apartado No. 237, Bogotá, Columbia
1901			Verteuil, Joseph de, Clarence St., Port of Spain, Trinidad, B.W.I.
1897			Viccajee, F. K., H.H. The Nizam's Mint, Hyderabad, Deccan, India
1897			Vinter, P. J., M.A., 33, Lynton-road, Acton, W.
1884			‖Voelcker, Edward William, 22, Tudor-street, Blackfriars, E.C.
1884		C. 1891-5 1902-	‖Voelcker, John A., Ph.D., 20, Upper Phillimore-gardens Kensington, W.
1889			‖Voss, Walter Arthur, Melrose, Whitworth-road, Brondesbury, N.W.
1885			Vulté, Hermann T., Ph.D., College of Physicians and Surgeons, 437, West 59th-street, New York City, U.S.A.
1899			Wade, A. L., 28, West Kensington-gardens, W.
1901			‖Wade, F., Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.		Wade, John, B.Sc. (Lond.), 7, Trinity-square, S.E., and Guy's Hospital, S.E.
1901			Wager, Morton, 63, Dark-lane, Batley, Yorkshire
1894			‖Wagner, W. G., Glyndhurst, Ealing Common, W.
1884			Wainwright, J. Howard, Ph.D., 159, Front-street, New York City, U.S.A.
1893			Wait, Chas. E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada
1897			Waite, W. H., M.A., Park-road, Halifax
1899			Walden, A. F., M.A., New College, Oxford
1897			Walford, S. M., Wyncote, Hatherlow, Stockport
1868			‖Walker, Maj.-Gen. Alexander, C.S.I., R.A.,
1881			‖Walker, Archibald, B.A., 8, Crown-terrace, Dowanhill, Glasgow
1898			Walker, A. Jamieson, Ph.D., B.A., Municipal Technical College Derby.
1900			Walker, A. J., 1, Linton-road, Hastings
1899			Walker, Charles, c/o T. B. Walker, Esq., School of Mines, Charters Towers, Queensland

Date of Election.			
1894	Trans.		Walker, Chas. H. H., M.A., 41, Richmond-road, Oxford
1890	Trans.	C. 1899-	‖Walker, James, Prof., D.Sc., F.R.S., 19, Springfield, Dundee
1865	Trans.		‖Walker, J. F., M.A., 45, Bootham, York; and Sidney Sussex College, Cambridge
1890			Walker, James S. H., M.B., C.M., Clinical Research Association, 1, Southwark-street, S.E.
1888			Walker, J. T. Ainslie, 2, Claude-road, Upton Manor, E.
1897	Trans.		Walker, J. Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey Manchester
1898			Walker, Samuel, M.A., D.Sc., 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1901			Wallace, H. G., 10, Elm-park-mansions, Chelsea, S.W.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, Ph.D., 7, Franklin-place, Morristown, N.J., U.S.A.
1898			Waller, H. F., School of Mines, Zeehan, Tasmania
1883			‖Walmsley, R. Mullineux, D.Sc., Northampton Institute, St. John Street-road, Clerkenwell, E.C., and 23, Hilldrop-road, Camden Town, N.W.
1888			Walrond, Edward Dalrymple, B.A., North Eastern Counties School, Barnard Castle, Durham
1896			Walton, R. H., Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884			‖Walton, Thomas Ulrick, B.Sc., F.I.C., Colonial Sugar Refinery Co., Sydney, New South Wales
1864			Ward, George, Buckingham-terrace, Headingley, Leeds
1895			Ward, G. J., Hallam Fields, Ilkeston
1891			Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875			Wardle, Sir Thomas, F.G.S., Leek, Staffordshire
1863	Trans.	C. 1874-5 78-81 V.P. 89-93	‖Warington, Robert, Prof., F.R.S., High Bank, Harpenden, St. Albans
1893			Warmington, Edward A., Ph.D., F.I.C., 21, Church-road, Moseley, Birmingham
1871			Warner, George Joseph, Halton Villa, Widnes
1894			Warren, W. L., 12, Westland-row, Dublin
1888			Warrick, Frederic Walmsley, 7, Portpool-lane, E.C.
1887	Trans.		Warrington, Arthur Walley, M.Sc., Craven Lodge, Rainhill.
1895			Warrington, T. C., 29, Stockwell-street, Leek, Staffs.
1882			Waterfall, Charles J., 4, Queen-square, Bristol
1900			Waterhouse, G. A., B.Sc., B.E., Ellerslie, Birrell-street Waverley, N.S.W.

Date of Election.		
1901		‖Waterhouse, Major-General James, I.S.C., Oak Lodge, Court-road, Eltham, Kent
1894		Waterhouse, Robert, c/o Messrs. W. A. Bishop and Co., Ltd., Dial Mills, Warrington
1889		Waterhouse, Wm. John, B.Sc., Plas Waan Fawr, Tregaron, Cardiganshire
1893		Watson, A. Forbes, Laboratory, Watling-street, Dublin
1885		Watson, Charles, 12, Agar-street, Strand, W.C.
1899		Watson, F. S., B.Sc., Stoneleigh, New Mills, Derbyshire
1887		‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1883		‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1896	Trans.	Watson, Wm., Rev., M.A., School House, Kingsbridge, S. Devon
1876		‖Watson, W. H., J.P., Steelfield-hall, Gosforth, Cumberland
1877		Watt, Alexander, c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1897		Watts, C. T. F., B.Sc., 2, Clauson-villas, Beckenham-road, Beckenham
1883	Trans.	Watts, Francis, Government Laboratory for the Leeward Islands, Antigua, W.I.
1872	Trans.	‖Watts, John, D.Sc., Merton College, Oxford
1878	Trans.	Watts, John I., Fairleigh, Hartford, Cheshire
1888		Way, Edward J., F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal
1901		Wayland, W. A., 12, Albert-road, St. John's, S.E.
1902		Webb, A. J., B.Sc., 73, Seefeldstrasse, Zürich, V.
1883	Trans.	Webster, C. S. Stanford, Malvern House, Redland, Bristol
1866		Webster, G. W., 33, Bridge-street-row, Chester
1877		Webster, William, 50, The Park, Blackheath, S.E.
1898		Weissmüller, E. C., II. Assistent an der Schweizische Agrikulturische Anstalt, Liebefeld, Bern, Switzerland
1901		Welch, G. E., B.Sc., Grammar School, Wakefield
1888		Welch, J. Cuthbert, Trail, British Columbia
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen N., The Gas Co., Colombo, Ceylon
1884	Trans.	Wells, James S. C., Ph.D., Columbia University, New York City, U.S.A.
1890		Wells, S. Russell, B.Sc., M.D., 24, Somerset-street, Portland-place, W.
897		Welsh, John, Kelsborrow House, Delamere, near Chester
888	Trans.	Werner, Emil A., 5, Church-avenue, Rathmines, Dublin
886		Wertheimer, Julius, Prof., B.Sc., B.A., F.I.C., Merchant Venturers' Technical College, Bristol
897	Trans.	West, C. A., F.I.C., Royal College of Science, South Kensington, S.W.; and 95, Oakhill-road, East Putney, S.W.

Date of Election.		
1899		West, G. H., B.Sc., County School, Pembroke Dock
1898		Weston, F. E., 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry A., Messrs. Parke, Davies & Co., Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence, J. de, 172, Erlanger-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc., Lond., 29, Norman-road, Canterbury
1894		Wheeler, H. L., Ph.D., The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest,
1897		Wheelwright, E. W., B.A., Ph.D., Greenholme, Westfield-road, Acock's-green, near Birmingham
1897		While, A. J., Whinsfield, Barrow-in-Furness
1898		Whitaker, E. T., M.B., B.Sc., Southfield, Kingsland, Shrewsbury
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford Yorkshire
1899		White, A. Lee, B.Sc., 1, Grange-road, Clifton, Bristol
1893		White, H. C., Prof., The University, Athens, Georgia, U.S.A.
1891		White, Henry, 2, Bransby-street, Upperthorpe, Sheffield
1899		White, H. Fox, 52 Royal York-crescent, Clifton, Bristol
1889		‖White, John Isawoo, M.A., F.I.C., Ngaputaw, Bassein, Lower Burmah
1862		White, Leedham, 2, Lime-street-square, E.C.
1897		White, P. T., Horton Field, West Drayton, Middlesex
1893		White, William Gilchrist, 261, Broom-lane, Levenshulme, Manchester
1885		Whitehead, Henry H., Holland House, Spring-grove, Isleworth, W.
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, P. L., 7, Lindsay-terrace, Lawrence-street, Dowanhill, Glasgow
1889		Whitehouse, William, Albany House, Bradmore, Wolverhampton
1886	Proc.	Whiteley, R. Lloyd, 20, Beeches-road, W. Bromwich
1892		Whiteside, John Lowe, 51, Cannon-street, Bolton
1863		Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, C. J., West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, St. Annes-on-the-Sea
1889		Whittam, Matthew, M.A., 68, St. Peter's-road, Leicester
1901		Whittle, James, 30, Bridge-street, Morpeth
1900		Wiechmann, F. G., Ph.D., P.O. Box 79, Station W., Brooklyn, New York, U.S.A.
1889		Wigan, Basil P., Rhondda Valley Brewery Co., Treherbert
1895		Wigley, H. F. A., Etruria, Gravesend
1896		Wigner, J. H., Ph.D., University College, Dundee
1896		Wilcox, A. J., Old Springs, Market Drayton, Salop

Date of Election.			
1891			‖Wild, John, Bredbury House, Bredbury, Stockport
1898			Wild, W. E., B.Sc., 22, Daisy Bank-road, Longsight, Manchester
1898			Wilder, F. L., Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans.		Wilderman, Meyer, Ph.D., B.Sc., Davy-Faraday Laboratory, Albemarle-street, W.
1881			Wilkes, J. P., 54½, Old Broad-street, E.C.
1893			Wilkinson, John, Grimesthorpe Gas Works, Sheffield
1885			Will, Wm. Watson, 1, St. Agnes-place, Kennington Park, S.E.
1891			Will, W., Prof., Ph.D., Colonie Grunewald, Boothstr. 32, bei Berlin.
1862	Trans.		‖Williams, C. Greville, F.R.S., F.I.C., 21, Bournevale-road, Streatham, S.W.
1895			Williams, Evan, Bradford-road Gas Works, Manchester
1892			Williams, John, Government Laboratory, British Guiana
1883	Proc.		Williams, Rowland, Sunny Lea, Aldcliffe-road, Lancaster
1891			Williams, Seward W., c/o Seabury and Johnson, 8, Brighton-avenue, East Orange, New Jersey, U.S.A.
1872			‖Williams, Thomas, Chemical Laboratory and Assay Office, A, Queen-avenue, 10, Dale-street, Liverpool
1899	Proc.		Williams, W. A., c/o Mr. Smith, 15, Barclay-place, Edinburgh
1885	Trans.		‖Williams, Walter Collingwood, B.Sc., 68, Grove-street, Liverpool
1874	Trans.		‖Williams, W. Carleton, B.Sc., 23, Broomgrove-road, Sheffield
1892			Williams, William, County Offices, Westgate-street, Cardiff, and 63, Plymouth-road, Penarth
1878			Williams, W. J., 2215, Bridge-street, Frankford, Philadelphia, U.S.A.
1848	Trans.	C. 1850-3 58-60 V.P. 54-7 61-2 P. 63-5 69-71	‖Williamson, A. W., LL.D., F.R.S., High Pitfold, Haslemere
1898			Williamson, J. A., 14, Milton-avenue, Highgate, N.
1874	Trans.		‖Williamson, Robert, Low Walker, Newcastle-on-Tyne
1886	Trans.		Williamson, Sidney, Fairholme, Esher, Surrey
1898			Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1896			Wills, E. Chaning, M.A. Cantab., Eastdown House, East Down, Barnstaple
1872			Wills, Jos. Lainson, 133, Midwood-street, Flatbush, Brooklyn, New York, U.S.A.
1892	Trans.		Wilsmore, N. Y. M., Bühlstrasse 7, Göttingen, Germany
1885			Wilson, A. C., Borough Hall, Stockton-on-Tees
1894			Wilson, A. Poole, 2, James-street, Omagh, Co. Tyrone, Ireland
1879			‖Wilson, Charles J., 14, Old Queen-street, Westminster, S.W.
1894			Wilson, Christopher, The Grammar School, Manchester
1883	Trans.		‖Wilson, David, D.Sc., Carbeth, Killearn, by Glasgow
1901			Wilson, Duncan, Magdalen College, Oxford

Date of Election.		
1899		Wilson, F. R. Leyland, M.A., Charterhouse, Godalming
1895		Wilson, H., 146, High-street, Southampton
1875		Wilson, James, M.A., Barrister-at-Law, 2, Essex-court, Temple; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, 6, Fenchurch-buildings, E.C.
1895	Proc.	Wilson, John, B.Sc., Battersea Polytechnic, S.W.
1899		Wilson, John, 148, Higham Hill-road, Walthamstow
1891		Wilson, John Henry, A.I.C., Glenthorn, Northumberland-road, Coventry
1890		Wilson, J. Mitchell, M.D., County Hall, Beverley
1901		Wilson, J. Scott, M.D., C.M., D.P.H., Bradford-street, Walsall
1900		Wilson, L. P., 123, Chadwick-road, East Dulwich, S.E.
1871		‖Wilson, William John, c/o Paget Prize Plate Co., Watford
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich
1874		Wiltshire, Thomas Pemberton, c/o Tartar Chemical Company, 9th-street and Gowanus Canal, Brooklyn, New York, U.S.A.
1893		Winder, Edward Humphreys, c/o Dr. W. H. Winder, H.M. Convict Prison, Aylesbury
1894		Wingate, Hamilton M., B.Sc., Laboratory, Princes-street, Auckland, New Zealand
1895		Wingfield, T. R., 5, Bromwich-street, Bolton
1876		Winser, Percy James, Heath Field, Bebington, near Birkenhead
1891		Winterton, A. W., Nenedale House, Wellingborough
1898		Witham, Ernest, The Grammar School, Rotherham
1876	Trans.	Witt, Otto N., Geh. Rath, Prof., Ph.D., 21, Siegmundshof, Berlin, W.
1896		Wolfenden, J. H., B. Sc., 381, Oldham-road, Failsworth, Manchester
1902		Womersley, Charles Edward, 17, Kilpin-hill, near Dewsbury
1889		Wood, Charles, 21, Queen's-road, Bradford, Yorks
1860	Trans.	‖Wood, Charles Henry, 16, Festing-grove, Southsea
1898	Trans.	Wood, T. B., M.A., Gonville and Caius College, Cambridge
1884		Wood, William H., B.A. (Oxon.), La Martinière, Calcutta
1900		Woodbridge, W., Central Technical College, Exhibition-road South Kensington, S.W.
1871	Trans.	Woodcock, Reginald C., The Sanitas Co., Ltd. 636 to 642, West 55th-street, New York City, U.S.A.
1898		Woodhead, S. A., B.Sc., Agricultural College, Uckfield, Sussex
1898		Woods, C. W. T., 10, Tudor-road, Upper Norwood, S.E.
1892		‖Woods, Hugh, Westbury, Hornsey-lane, N.
1888		Woodward, James, B.Sc., B.A., F.I.C., 46, Selborne-road, Ilford, Essex
1889		Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1889		Woosnam, Richard W., 1, The Chase, Wavley Mount, Brentwood, Essex

Date of Election.			
1899			Wormell, T. W., B.Sc., 6, Walsingham-road, St. Andrews, Bristol
1884			‖Worrall, J. Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858	Trans.		‖Worsley, Phillip J., Rodney Lodge, Clifton, Bristol
1898			Wrench, C. A., 95a, Southwark-street, S.E.
1900			Wright, H. E., M.A., c/o Messrs. J. and R. Tennent, Well Park Brewery, Glasgow
1895			Wright, H. E., c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1878	Trans.		Wright, Lewis Thompson, 10, Norland-square, Holland Park, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		Wright, William T., 16, Montgomery-road, Sheffield
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, W. Fitzthomas, Wheatley-street, Coventry
1901			Wylie, A. S., 93, Manchester-street, Oldham
1885	Trans.	C. 1892-6 S. 98-9	Wynne, W. Palmer, D.Sc., F.R.S., Royal College of Science South Kensington, S.W.
1874	Trans.		Yates, Robert, 52, The Avenue, Beckenham, Kent
1886			Yoshida, Hikorokuro, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred C., 53A, Algiers-road, Ladywell, S.E.
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, F. S., M.A., Nonconformist Grammar School, Bishop's Stortford
1877			‖Young, Frank W., F.R.S.E., H.M. Inspector of Science and Art Classes, 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D., University College, Sheffield
1895			Young, H. Stow, c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 4, Plumstead Common-road, Woolwich, S.E.
1877			‖Young, J. Rymer, 42, Sankey-street, Warrington
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1898			Young, J. H., B.Sc., c/o Cassel Gold Extracting Co., Ruckill-road, Maryhill, Glasgow
1887			Young, John William, B.Sc., B.A., 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc., F.R.S., University College, Bristol; and 6, Windsor-terrace, Clifton, Bristol
1873			‖Young, W. C., Normanhurst, High-road, Romford; and Chemical Laboratory, 19/20, Aldgate, E.C.
1878			Zingler, Maximilian, 1, Harley-road, N.W.; and 16, Fenchurch-street, E.C.

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